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NWU Self-Directed Learning Series

Volume 3

# SELF-DIRECTED LEARNING RESEARCH and its impact on educational practice

Edited by

Elsa Mentz & Roxanne Bailey

NWU Self-Directed Learning Series
Volume 3

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AOSIS

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## Peer review declaration

The publisher (AOSIS) endorses the South African 'National Scholarly Book Publishers Forum Best Practice for Peer Review of Scholarly Books'. The manuscript was subjected to rigorous two-step peer review prior to publication, with the identities of the reviewers not revealed to the author(s). The reviewers were independent of the publisher and/or authors in question. The reviewers commented positively on the scholarly merits of the manuscript and recommended that the manuscript be published. Where the reviewers recommended revision and/or improvements to the manuscript, the authors responded adequately to such recommendations.

## Research Justification

This scholarly book is the third volume in an NWU book series on self-directed learning. It is devoted to self-directed learning research and its impact on educational practice. The importance of self-directed learning for learners in the 21st century to equip themselves with the necessary skills to take responsibility for their own learning for life cannot be over emphasised. The target audience does not only consist of scholars in the field of self-directed learning in Higher Education and the Schooling sector, but it also includes all scholars in the field of teaching and learning in the various education and training sectors. The book contributes to the discourse on creating dispositions towards self-directed learning among all learners and adds to the latest body of scholarship in terms of self-directed learning. Although from different perspectives, chapters in the book are closely linked together around self-directed learning as central theme, following on the work done in Volume 1 of this series (*Self-Directed Learning for the 21st Century: Implications for Higher Education*), to form a rich knowledge bank of work on self-directed learning. This book serves as a valuable contribution to the body of scholarship in self-directed learning.

In accordance with the requirements of the Department of Higher Education and Training, this book contains original content not published before and no part of the work was plagiarised.

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# Contents

# List of Abbreviations, Boxes, Figures and Tables Appearing in the Text and Notes

## List of Abbreviations

| | |
|---|---|
| ACT | Advanced Certificate in Teaching |
| AI | Artificial Intelligence |
| ANA | Annual National Assessment |
| ASCD | Association for Supervision and Curriculum Development |
| ATP | Annual Teaching Plan |
| BL | Blended Learning |
| CAPS | Curriculum and Assessment Policy Statement |
| CAQDAS | Computer-Assisted Qualitative Data Analysis Software |
| CAT | Computer Applications Technology |
| CBL | Case-based Learning |
| CDE | Centre for Development and Enterprise |
| CHAT | Cultural-Historical Activity Theory |
| CL | Cooperative Learning |
| CLT | Cognitive Load Theory |
| CoI | Community of Inquiry |
| CS | Computer Science |
| DBE | Department of Basic Education |
| DL | Deeper Learning |
| DSDL | Deeper Self-directed Learning |
| EFL | English as Foreign Language |

| | |
|---|---|
| EJISDC | Electronic Journal of Information Systems in Developing Countries |
| GROW | Goal, Reality, Obstacles, Way forward problem-solving model |
| HEI | Higher Education Institution |
| ICT | Information and Communication Technology |
| IK | Indigenous Knowledge |
| IS | Information Systems |
| IT | Information Technology |
| LMS | Learning Management System |
| LTM | Long-term Memory |
| MLE | Mediated Learning Experience |
| NDP | National Development Plan |
| NEEDU | National Education Evaluation and Development Unit |
| NOS | Nature of Science |
| NRF | National Research Foundation |
| NWU | North-West University |
| PBL | Problem-based Learning |
| PD | Professional Development |
| PIRLS | Progress in International Reading Literacy Study |
| ProjBL | Project-based Learning |
| PUI | Primarily Undergraduate Institutions |
| RBI | Royal Bafokeng Institute |
| RBL | Research-based Learning |
| RBT | Research-based Teaching |
| RLL | Research-led Learning |
| ROL | Research-oriented Learning |
| RTL | Research-tutored Learning |
| SACLA | Southern African Computer Lecturers Association |
| SAMR | Substitution, Augmentation, Modification, and Redefinition |

| | |
|---|---|
| SAMS | School Administration and Management System |
| SCT | Social Constructivist Theory |
| SDL | Self-directed Learning |
| SDLI | Self-Directed Learning Instrument |
| SDLRS | Self-directed Learning Readiness Scale |
| SEP | Stanford Encyclopedia of Philosophy |
| SES | Socio-economic Status |
| SHRM | Society for Human and Resource Management |
| SLP | Short Learning Programme |
| SPSS | Statistical Package for the Social Sciences |
| SRL | Self-regulated Learning |
| TALL | Test for Academic Literacy |
| TASC | Thinking Actively in a Social Context |
| TSCL | Technology-supported Cooperative Learning |
| TSCL PD | Technology-supported Cooperative Learning Professional Development |
| TIMMS | Trends in International Mathematics and Science Study |
| TIMSS | Trends in International Mathematics and Science Study |
| TLO | Transferable Learning Orientations |
| TPACK | Technological Pedagogical Content Knowledge |
| TRN | Teaching-research Nexus |
| VAT | Value-added Tax |
| VNOIK | Views-on-the-nature-of-indigenous-knowledge |
| WM | Working Memory |
| YASS | Yunnan Academy of Social Sciences |
| ZPD | Zone of Proximal Development |

**List of Boxes**

## List of Figures

## List of Tables

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# Foreword

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Traditionally, educational institutions have focused on developing learners' abilities to follow instructions and memorise information that will enable them to succeed in standardised tests. Although some memorised information is very useful, this approach, which unfortunately still predominates in most classrooms, is woefully inadequate in our current environment of rapid change. New technologies emerge daily, new jobs follow, and many jobs become obsolete. In 2014, LinkedIn's top ten jobs were jobs that had not existed five years earlier. According to *Ed Surge* (Weise 2018), the first people who will live to be 150 have already been born, and some are predicting that careers will eventually last 80–100 years. Imagine the changes in that timespan. Now self-directed learning is the most crucial skill for student success.

This book has been prepared largely by faculty members at one of the most forward-thinking faculties of education in the world. The Faculty of Education at North-West University adopted self-directed learning as one of their strategic objectives in 2010 and has made great strides in research and practice in self-directed learning. The North-West University (NWU) now hosts a Self-Directed Learning Research Unit with more than 60 dedicated scholars. This book shares some of the wisdom they have acquired, along with their latest research results.

Opportunities to build skills and attitudes in self-directed learning exist in every educational activity, but the NWU researchers have focused on the most promising approaches. To investigate these, they have used an action research strategy based on continuous trials, assessment and refinement to develop

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instructional approaches that not only prepare students for the immediate future, but also equip them for a lifetime of meeting new challenges through self-directed learning and preparing their students to do the same.

In this valuable book, you will discover ways to design educational activities and approaches to promote self-directed learning—the key to adequately preparing our learners for a future we cannot even predict. The authors of these chapters are designing and testing the learning ecosystem of the future.

Note: Weise, M.R., 2018, *We Need to Design the Learning Ecosystem of the Future*, viewed n.d., from https://www.edsurge.com/news/2018-02-22-michelle-weise-we-need-to-design-the-learning-ecosystem-of-the-future.

# Preface

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Self-directed learning (SDL) refers to a process in which students take responsibility for their own learning with or without the help and assistance of others. During this process, they determine their own learning needs, set their own learning goals accordingly, identify their own learning resources and strategies to reach the goal and eventually determine if they have achieved the goal (Knowles 1975). Although SDL initially stemmed from adult education, SDL researchers have recently extended their wings to all sectors of education from early childhood to tertiary education. The importance of SDL has gained momentum as the demand for skills to cope in a rapidly changing technological globalising world increased.

This collection of scholarly research on SDL specifically focusses on the impact of SDL research on educational practice. It starts in Chapter 1 with Jagals's unique personal reflection of a researcher in the field of SDL in which he provides guidelines to define and understand SDL research. The next four chapters (ch. 2 to ch. 5) deal with interventions in Higher Education to enhance SDL; Chapter 2, by Uys and Chigona, determines undergraduate students' experiences in becoming self-directed researchers. They conclude that SDL capabilities of students can be restricted by providing too much direction to students in

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terms of how they need to perform a task or assignment. The restriction of lecturers in terms of fixed curriculum outcomes can also limit SDL opportunities. In the following chapter, Van Zyl and Mentz (ch. 3) provide guidelines for deeper SDL and indicate how the effect of the implementation of the guidelines in a Computer Applications Technology class can improve students' inclination towards lifelong learning. In the ensuing chapter (ch. 4) Bosch and Laubscher use cooperative learning in a blended learning environment in a higher education context and indicate how a teaching presence can be established by the facilitator to enhance SDL. Bunt and Grosser conclude the interventions in Higher Education in Chapter 5 by discussing the relationship between critical thinking and SDL and report on a Puzzle Video Game-Cognitive Enrichment Programme for the development of critical thinking among first-year BEd students.

Chapters 6–8 report on SDL research on teachers in different contexts. Verster, Mentz and Du Toit-Brits (ch. 6) focus on the relevance of teachers gaining control and autonomy over their own curriculum as praxis when looking from the perspective of an SDL capability approach. They conclude that teachers with a traditional curriculum stance only utilise limited SDL capabilities, while teachers with a contemporary curriculum stance utilise more SDL capabilities. In Chapter 7, Mentz and De Beer report on a professional development programme for teachers to enhance SDL and indicate the versatility of Cultural-Historical Activity Theory (CHAT) as a research lens in SDL inquiries. In the following chapter (ch. 8), Sekano, Laubscher and Bailey provide valuable insights into the experiences of the facilitator of a technology-supported cooperative learning professional development programme, developed to promote in-service Mathematics teachers' SDL skills. Although some of the interventions reported are focused on Higher Education and some on teacher education, it is clear that several of the researchers highlight the advantages of incorporating cooperative learning efforts when attempting to develop any individual's SDL.

The last two chapters focus on interventions with learners to enhance their SDL skills. The value of cooperative learning is also evident in Chapter 9 where De Lange, Petersen and Breed use cooperative learning as scaffold to develop Grade 10 Life Sciences learners' SDL skills. They found that cooperative learning indeed develops the learners' SDL skills. Finally, in Chapter 10, Geduld and Mdakane indicate that learners need self-regulation skills to become self-directed in their learning. Their findings revealed that the quality of parental involvement and the extent to which parents develop their children's self-regulated learning (SRL) skills are highly influenced by their parenting styles, their educational levels and their socio-economic status. They recommend guidelines as to how parents can be supported to develop their children's SRL skills with homework activities.

Collectively, the contributions in this book illustrate the diverse contexts and facets of research on SDL and the meaningful changes possible from strategies such as cooperative learning to enhance SDL. Together these chapters provide insight into SDL research and its impact on education practice.

Note: Knowles, M.S., 1975, *Self-directed learning: A guide for learners and teachers*, Association Press, New York, NY.

Chapter 1

# Defining research focus in self-directed learning: An autoethnographic reflection

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## Abstract

This chapter presents a study of my personal educational research experiences in academia, particularly in the field of SDL. A series of reflections follow, based on an autoethnographic self-study of personal journal and diary entries. 'Autoethnography' refers to an approach by which a researcher composes an understanding of personal lived experiences. Self-reflective autoethnography

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research challenges various research methods and activates the research process as a self-conscious act. Over the course of 10 years, I have documented my personal reflections on educational research in narrative journals. These include a series of entries either as a student, author or supervisor in the field of SDL. In this chapter, I apply the autoethnographic approach as a reflective methodology to describe and methodically analyse these entries and, in this process of reflection, draw on key research accounts in my academic career to define an early career research focus. The accounts are presented in three vignettes of mediators of ontological, epistemological and methodological tools that have collectively facilitated metacognitive awareness to promote and understand SDL. By setting up these tools, several research foci opened as cues to an emerging research focus to conceptualise my research identity. Based on the personal nuance that this reflective method offers, the chapter illustrates a series of vignettes of personal memoirs on particular instances in my academic career and closes with guidelines to define a research focus in SDL for early career researchers.

**Keywords:** Research focus; Research identity; Self-directed learning; Metacognitive awareness; Research methodology.

# ■ Introduction

Numerous people, of which I am one, are searching for meaning and purpose in their lives (Frankl 1985). As is reported on the typical journey of young academics by Lamb and Davidson (2002:1132), I too have searched for and established a sense of personal identity as an extended self within the university as an organisational context. Similar to the experiences of Naidu (2014:11) within the academic setting, I noticed that I hold a research identity that is operative, and aimed towards developing self-determination and is, consequently, influenced by the context of my lived research experiences. Yet, it is this self-actualisation that develops from one's self-identity, which inspired me to instinctively reflect on my research identity and research focus.

This was carried out to define a deeper and more meaningful approach to my work life, other than merely reciting the contextual influences and examples held by others towards defining a personal research focus. This chapter presents such a personal narrative of my educational research journey across the past 10 years of involvement in academia. It showcases how I found myself choosing different research foci that, over time, established my research identity.

As the roots of autoethnography are embedded in humanism, the fundamental idea of 'self' or that which constitutes personal and research identities is prevalent. The aim of this self-study was to explore my educational research experiences in SDL and to understand the progress of my research identity development towards defining a personal research focus. The main question that drives this autoethnographic reflection is: How did my educational research experiences in metacognition define a personal research focus in SDL? The narrative that follows aims to deepen a personal understanding of the educational influence from both mentorship and readership towards fostering a sense of research focus across ontological, epistemological and methodological tiers as emerging mediating tools.

## ■ Statement of the problem

Research identity consists of various elements that, when pulled together, represent the focus and intention of a researcher's academic life. Some basic examples of these elements include the researcher's name appearing on publications and websites of academic organisations, profiles and citations of recent publications, involvement in national and international projects and other research activities, institutional affiliations, professional collaborations, peer reviews, postgraduate student examinations and editorial activities – all of which lead to acknowledgement of one's research. By drawing on all these elements, it is possible to acquire an objective account of the researcher's identity – this is a statement of *who* did *what*. However, these elements do not in themselves hold the true identity of the researcher – the reason *why* he or she does the research. A researcher whose true identity is revealed is someone who is in touch with, as Kirk and Lipscombe (2019) put it, the id, the ego and the super ego, and it is here where tensions exist as the three identities resonate the true focus and core of the researcher as a researching 'self'. What this implies is that research identifies more than the researcher's name or publications and project affiliations; it involves one's character, interests and circumstances – all of which should be considered when deciding on what new projects to be involved in, and what focus will spark joy and meaning in one's academic career. This will provide an overall picture of intentions behind the emerged research foci.

In light of recent movements in SDL, as a core theoretical development in adult learning, I too grappled with these aspects of research identity. Mainly, during my past 10 years in academia, I have been asked numerous times what my research focus is. This was a difficult question to answer as I did not set out from the start a clear research (identity) trajectory of my current and the future career in educational research. The boundary, however, between one's research identity and how the individual defines himself or herself in the research focus seemed faint.

## ■ Conceptual framework

In a variety of contexts, SDL has been established as a research area under the auspices of the Society for Self-Directed Learning, which publishes a quarterly journal. Self-directed learning is also broadly applied both within and outside (educational) contexts. It is the main focus of publications in the *International Journal of Self-Directed Learning* and the core of research activities in the *research focus area of self-directed learning*. Being part of a group of South African scholars on SDL, I experienced and noticed similar confusion amongst scholars, about the term 'self-directed learning'. Some scholars understand that SDL suggests a process, a concept, a model, a theory or a characteristic

(Van der Walt 2019:3). To conceptualise SDL, it was important to establish the ontological nature of this term. Furthermore, in accordance with the identity theory (Burke & Reitzes 1991) and the CHAT (Kajamaa, Kerosuo & Engeström 2011), SDL can be viewed as an activity system of educational research experiences, as is the case in this reflexive methodology. The researcher who reflects on SDL research as a field can therefore raise awareness of the mediating tools to reach a particular research outcome or objective (such as enhanced autonomous learning).

## Three worlds of research

Distinguishing between research problems and real-life problems, Mouton (2009) explains that scholars are often confused between the worlds in which these problems exist. The idea of different research worlds has accumulated over the course of my own experiences with and thinking about research, and has led me to believe that Mouton's statement is true. The first world, as Mouton (2009) explains, is regarded as the world in which the object of the study lies (or the unit of analysis). Often, it is a real-life object, and when these objects are being studied, they present the material or empirical character of the object and are referred to as empirical research problems. To collect data (those empirical characters) regarding these problems, actual artefacts, samples of specimens, documented historical events and other physical material are used and experiences are reflected upon. This first world therefore contains the phenomenon or object, the *wha*t of the study, and is considered to be ontological in nature. The second world contains the ideas, writings and reflections of others based on their perceptions and perspectives of the first world of ontology, typically in the form of theories, models, concepts or constructs of reviewed literature and knowledge, and takes on a form of non-empirical study. This second world can be regarded as the world of epistemology, as it refers to the study of the empirical. Mouton (2009) also explains a third world – a world where meta-science prevails.

Mouton (2009) explains that this third world could be conceptualised when categorising these perspectives on ontology and epistemology, and reflecting on the implications thereof for understanding the first as well as the second world problems. This necessitates a nuanced understanding of the overarching approaches, strategies and paradigms that govern the ontological and epistemological state of the research (problem). As such, the explanation by Tennis (2008) offers an understanding of a third research world, namely the world of methodology. As the research problem includes characteristics of the first and the second world, it is apparent that the context or environment of the research influences the design of the research. In this sense, there are particular research paradigms (or scientific worldviews) that call for a positivistic (quantitative), ethnographic (no design), interpretivist (qualitative) or pragmatic (mixed method) form of research. The world of methodology expresses these in terms of the paradigms, approaches, designs, population and sampling strategies, as well as the methods concerning the collection and analysis of data (Mouton 2009). Some readers might argue that there exist, for that matter, other worlds as well; for instance, the world of theology, anthropology, ethics, teleology, deontology, cosmology or axiology (Clouser 2005). However, I view these 'other worlds' rather as philosophical theories and place them in line with Clouser's (2005:66) explanation where, accordingly, these philosophical theories are abstract inventions that aim to synthesise all aspects of experience '(e.g. quantitative, spatial, kinetic, physical, biotic, sensory, logical, historical, social, economic, aesthetic, justitial, ethical or fiduciary)' into an overview of (1) a general theory of reality (ontology) and (2) a general theory of knowledge (epistemology). These other worlds can then be conceptualised as truths that serve as particular frameworks or points of reference from which the ontology, epistemology and methodology can be viewed and understood. To explain this, take for example a case where a researcher holds a particular religious belief underlying SDL. A study by Naidu (2014) presents a case where personal and contextual factors such as religious views influence SDL.

## The world of ontology

The ontology of research represents the philosophical theories about the context, environment, conditions and circumstances, practical problems and social activities about the reality in which the research is taking place (Mouton 2009). The ontology of research, therefore, represents the natural and phenomenological occurrences of the research world in terms of everyday experiences. According to Mouton (2009), researchers should anticipate a research idea as a form of scholarly service where the form of service can be contributed as research ideas that can emerge from any number of experiences within different localities (or ontologies), such as the school, the classroom, home situations, family relations or the university, as physical spaces. All these local places can serve as ontological, contextualised spaces (Ellis & Bochner 2000) in which education resides. It is almost impossible to imagine such a space without any social and interpersonal relations (Jagals 2018). A theory about the nature of the metacognitive processes that follow in these discussions pertains to the theory of metacognitive locale (Jagals 2018), which explains that the ontology of reality undergoes constant development and, as such, changes the way in which we perceive the world of learning (Jagals & Van der Walt 2016). In light of this, data take on a physical form and can be described as the elements of reality that reflect the ontological nature of the research (e.g. documents, notes, artefacts and other forms of physical data). Based on a variety of educational research theories (e.g. social constructivism, metacognition and zone of proximal development), a series of tools was conceptualised to facilitate metacognitive awareness for my research purposes. These tools can be classified into three types of research tools:

1. ontological tools, which comprise any activities, tasks or mediators that create opportunities for reasoning and meaningful learning (Painho & Curvelo 2012:99) – these are usually task-based activities, such as problem-solving

exercises and hard copy or virtual cases that stimulate reflection
2. epistemological tools, which involve any mediator that requires its user to reason, formulate hypotheses or make predictions and could include religious and mythical aspects, such as a set of signs, symbols, verbal utterances or gestures (Ijiomah 2005:78)
3. methodological tools, comprising methods or approaches to capture data on phenomenology, such as ethnography, narratives, social network analysis and observations (Maton, Perkins & Saegert 2006:17).

Conceptually, these tools are considered so unique in their field that I think of them in light of Mouton's (2009) description of three worlds. When reflection is mediated by these tools, they can facilitate metacognitive awareness (see e.g. Jagals & Van der Walt 2016:157). As a result, meta-theoretical categories of awareness emerge, for example, meta-affect, metacognitive knowledge and metacognitive self-regulation, which all correlate with SDL (Jossberger et al. 2010) and can promote the process of SDL (Knowles 1975:18) and aid in understanding the terminology of SDL (Van der Walt 2019:3).

## The world of epistemology

Epistemology exists as the ideas or opinions on the experiences gained in, with, from and within the ontological space (Tennis 2008). Some examples of epistemology of research include theory, content, ideas, processes, questions, dimensions and other forms of knowledge-constitutive interest (Mouton 2009). From this view, epistemology (i.e. knowledge about ontology) serves the scholarly purpose as it illuminates the understanding of the objects within ontology, and can be considered as the fabric of scholarship. An example of this knowledge involves life world interpretations and personal philosophical lenses, such as worldviews, which, in turn, help shape thinking across and from less to more complicated ideas. Tennis (2008) identifies three such epistemological localities in terms of their paradigmatic philosophies, namely constructivism, interpretivism and pragmatism.

## The world of methodology

The assumption now is that these epistemological truths, as regarded from the ontological space, should be understood as a rich system of integrated complexities (i.e. ideas) that emerge from experience and the perception formed about it. It is through such deliberate questioning that theory or model becomes tangible, that is, practical and visible in the research practice. By deliberately focusing on the experiences and perceptions, the researcher can generate a research method and approach or an inquiry of design to the extent of mimicking, exploring, determining or synthesising the epistemologies that inform about the ontology. Typically, the methodology will involve the tools, strategies, techniques, approaches, design and methods applied to collect and generate data that represent a series of incidents or events that took place in the world of ontology but were perceived, interpreted and viewed from the ideas of the world of epistemology (Mouton 2009).

# Metacognitive awareness to facilitate or understand self-directed learning

To understand what is meant by the term 'metacognition', I refer to Schoenfeld's (1992) following four skills:

1. the person's information (e.g. self-knowledge)
2. the utilisation of techniques (e.g. knowledge of strategies)
3. the checking of execution (i.e. monitoring progress)
4. the conviction arrangement of the person's degree of progress, that is, what they believe their level of success is.

These four skills associate directly with Flavell's (1979:n.p.) discussion on 'metacognition' – the awareness of knowing one's own and other's knowing. In this sense, metacognition fills in as the fuel that ignites self-coordinated learning.

In 2018, Jagals (2018) published a chapter with the purpose to conceptualise my understanding of metacognitive awareness within a notion of metacognitive sentience. The idea held is that (Jagals 2018):

> [/]f the educator is aware and has knowledge of the components of metacognition, that is, the planning, monitoring and evaluating capacities, he or she can look out for and cater to these particular skills within the curriculum material. If these skills can be fostered in the classroom by means of the available curriculum (or not), then it suffices sensory or visible quality of metacognition. In essence, metacognitive sentience is a philosophical theory of the underlying components of metacognition that one becomes aware of as visible or invisible, implied or explicitly implied, within the curriculum. (p. 143)

## Metacognitive knowledge

Metacognitive knowledge consists of learners' understanding of themselves as a person, having knowledge of the task of learning as well as the strategies used to complete the task successfully (Flavell 1979). In light of this, Jagals (2018) explains that these types of knowledge simultaneously lie on three tiers of metacognitive knowledge, namely, declarative, procedural and conditional knowledge. Declarative knowledge involves self-knowledge in terms of personal knowledge, one's purpose or goals set and how one is likely to approach learning (Little & McDaniel 2015). Reflecting on experiences with education may, for instance, facilitate awareness of what the task requires, what possible alternative approaches could be considered and what information or assistance should further be sought. Procedural knowledge permits the individual to practise *knowing how to know* (i.e. declarative knowledge) by means of managing (therefore regulating) the awareness of person, task and strategy variables (Minichiello et al. 2019). Conditional knowledge indicates the level of awareness of why, when and where particular approaches and conditions can be applied (Jagals 2018).

## Metacognitive regulation

The regulation of metacognitive know-how includes such skills as knowing how to plan, monitor and evaluate (Little & McDaniel 2015). The skill of planning conveys the expectations and potential prospects recognised before a specific problem-solving behaviour starts evolving. This occurs through a selection of precise knowledge of the person, and the specific task and method that the problem-solving task requires. Monitoring during these tactics refers to the perception of non-public success and consequences in an incessant scrutiny of whether the task conditions show or require particular prior knowledge or skills (Jagals & Van der Walt 2016). Through such a reflection, any errors or misconceptions could be corrected by paying attention to the awareness of the person, task and strategy knowledge that emerged from the experience. In addition, through rephrasing the task and posing different questions, an individual can boost reflective thinking. When the task is finished, the entire task progress can be reflected upon to determine whether the answer marks the learning experience as a practically meaningful one, and whether the emerging person, task and strategy knowledge applied contribute metacognitive knowledge (Flavell 1979). Reflection, therefore, continuously occurs throughout the process and regulates the knowledge to solve the task.

# Self-directed learning as transcendent education

The term 'self-directed learning' can refer to an assortment of characteristics, for instance, taking responsibility to plan, monitor and evaluate one's learning (Jagals 2018). Self-directed learning manifests as individuals learning cooperatively with others. Such learning, it seems, inspires self-improvement and expands self-awareness. In terms of this awareness, Knowles (1975:103) made a remarkable statement when introducing the pioneering work on SDL, that '[t]he individual is an energy system with modifiable intelligence, and possesses an inertial guidance for self-feedback and motivation, and this is in continuous activity'. This statement suggests the role of an inner hidden force to raise consciousness of the self. I see this force as metacognitive awareness, as explained in Jagals (2018), and define it as the capacity to self-transcend towards what is (considered) needed.

In preparing my writing on SDL, I reflected deeply on the work of Moore (2000). Self-directed learning has become the invisible ink of expectation (Hayler 2012:3) in my research outputs, as the fiscal austerity of the faculty demanded performance in terms of research outputs that reflect and contribute to the research focus (area or entity). It is with this memory in mind that I needed to have clarity on what SDL is and how it allows for a transcendence (of myself) between the three research worlds.

This understanding of the term 'self-directed learning' provokes scholars to (re)conceptualise the meaning of the term for themselves, especially in a coherent and practical sense. The publication by Knowles, Holton and Swanson (2005:64), where these authors reflect 'on the persistent confusion surrounding the meaning of "self-directed learning"', was considered to be the guiding work to do. Although there does exist some uncertainty 'as to what the conceptual, theoretical and methodological nature of self-directed learning is', the fundamental principles remain consistent (Knowles et al. 2005:64).

The CHAT was regarded as an overarching theoretical lens to view the researcher as a subject within his or her own research endeavours that serves (in itself) as the context of the activity system. Understanding the various components of the CHAT in this sense (as being emerged in the activity system of research) offers an objective view on the self (as researcher).

## Cultural-Historical Activity Theory

The conceptual lens provided by the CHAT assisted me in understanding not just the system of research but also the ontological, epistemological and methodological worlds that constituted the process of defining a research focus. The CHAT can be regarded as a philosophical lens (from German philosophy and Russian theory) in the social sciences. The CHAT is commonly used as a principle of characterisation of the operation within an activity system (Engeström, Miettinen & Punamäki 1999). Based on this premise, the CHAT offered the analytical framework for analysis of the autoethnographic study where research serves as an activity system.

## Research as an activity system

I interpreted my *activity* as the one that represents the profession and the discipline of the subject, in this case myself as a researcher. The activity system, according to Engeström et al. (1999), mainly consists of six components. Engeström et al. (1999) explain these as follows:

1. *Subject*: Who are we as subjects within the system and what is our role?
2. *Object*: What is the objective or the intended outcome of my research?
3. *Tools*: What are the tools that we use to do our research, and which of these are most appropriate?
4. *Rules*: What are the laws or policies, the code of conduct and practices that administrate research (in terms of the research design and research activities)?
5. *Community*: Who are the populations and samples that we work with and engage with? To what extent are we engaged? In what ways do they influence our research activities?
6. *Division of labour*: How are research roles and responsibilities divided? Why are these tasks distributed in this way? Do these divisions produce any conflict?

It is possible, from this view, to imagine the third-generation activity theory of Engeström et al. (1999) as a possible theoretical means of exploring the nested nature of additional, or sub-activity, systems. To do so, an inside or alternative activity system is identified, which additionally describes how the activity system of research will connect with alternative activity systems through all of its elements. Obtaining a research focus, as outcomes, has an impact on, for instance, the research focus area, entities and larger academic organisations in which one's research is read and used. Such an understanding shows that there are various perspectives and values that arise as a consequence of the relations amongst various activity systems (e.g. the link with classroom practice) and also the object(s) that result from these interactions. The lifetime of an activity system (be it a decade, for instance) may also be underscored by various contradictions, confusions, discontinuities, upheavals and transformations, as was the case in my activity system. These experiences may stimulate or hamper the course of development in the activity system, and therefore its hypothetical product (of a defining research identity).

## Empirical design of the study

The features of autoethnography integrated into this study lend autoethnography to a predominant qualitative approach. The advantage of autoethnography as methodology involves the ease of access to data, because the researcher recalls personal experiences as presented, in this case, in the form of words and impressions (cf. Méndez 2013:282). In this way, I not only define a personal research focus but also stimulate others to reflect on their educational research experiences through an empirical inquiry (cf. Foster, McAllister & O'Brien 2005:46). Krall's fivefold model of hermeneutic analysis was applied when (1) venturing, (2) remembering, (3) comprehending, (4) embodying and (5) restoring the data (cf. Ellis 2004:171). With phenomenology at its roots, the conceptual–theoretical framework assisted in constructing meaning from reflections on educational research experiences as communicated in words and to search for underlying patterns that define the research focus. The method of data production involved a coherent narrative (cf. Cherry, Ellis & DeSoucey 2011:1) that allowed me to sieve through multiple layers of consciousness and, in doing so, arrange different accounts of educational research experiences chronologically. The accounts take the form of journal entries (cf. Ellis & Bochner 2000:742) and reflect not what happened, as a historical account would, but how I perceived the experiences from the perspective of this research identity. To analyse the data, the main strategy was to select key experiences, such as particular readings of academic texts, discussions with colleagues regarding research methodology, involvement in master's and doctoral studies as a student and (co-)supervisor, authorship of research articles, published chapters, attendance and presentation of research workshops, conferences and discourses, in my personal educational research life world to examine and categorise these experiences into themes of emerging interests.

To ensure validity and rigour of the data collection process, the data were represented and extended through triangulation with self-authored materials, such as impressions and reflective statements, to include explorations of various representations of the same autoethnography. In this sense, the material served as reference points and verification of the accounts (cf. Lynch & Kuntz 2019:17). Ethical issues of integrity were fundamental in giving a truthful version in the coherent narrative. Pseudonyms were used to protect the identity of any person involved in the narrative, written from an ethic of care and concern (cf. Ellis 2004:46).

Research paradigms seem established in their fields, and over time, major paradigms persist in this autoethnography. The paradigm of positivism, for instance, is considered dominant in its field, especially in Mathematics education research, and was the leading view throughout the first drafts of my master's study. I soon realised that the superiority of constructivism, idealism, relativism, humanism and, sometimes, hermeneutics featured as the second group of paradigms that I have conceptualised through interpretivism. The third paradigm argued for a more flexible and open methodology, such as multiple methods and mixed methods, where pragmatism assists as a lens to triangulate the positivist, post-positivist and interpretative frameworks. These paradigms are all integrated into a self-study, like lenses providing a kaleidoscope of ideas, which, therefore, lends itself to a predominantly qualitative approach.

## Methods for justification

Considering the journal entries as narrative text, the entries were analysed by means of *a priori* coding, following the advice of Saldaña (2015) regarding the development of a codes-to-theory model. In this sense, the conceptual framework informed the development of codes for personal analysis. All coded entries were categorised according to three vignettes (or scenes). First the texts showed a role of being a student in the research field of SDL. This developed to a role as researcher and publisher in SDL, which is followed by a role of a supervisor and presenter on SDL. These instances compiled the vignettes of the autoethnographic reflection. Within each vignette, the scenes were scrutinised against the conceptual framework, in particular to the three worlds of research, to determine how metacognitive awareness was facilitated in the narrative reflections of the research conducted. This specified particular methods and contexts of research. Thereafter, the emerging elements of the research focus were identified to determine the sub-themes of SDL research. These elements and contexts were then aligned against the three worlds of research, as described in the conceptual framework, to determine the mediating tools that drove the focus of the research. Because the focus of the autoethnography was on defining a personal research focus, based on narratives of educational research experiences, the findings do not portray any discussion on how this enlightenment of a personal identity serves as a foundation for learning. This, rather, could be argued from the point of transcendent education.

It is noteworthy, however, to comment on the journey of personal learning as a form of transcendent education. In this autoethnographic study, the researcher's personal act of learning was typical of trait-learning in self-directedness. It can, therefore, be argued that, in relation to what has been learnt, learning (as awareness) informs new learning through self-direction. Within my own research as an activity system, learning was considered a principle of characterisation of the operation within every research endeavour. The analysed diary entries reflect these learning experiences of an individual learning trajectory, and they are not intended as possible tension points for teaching to learn. Instead, as the discussion later demonstrates, facilitating metacognitive awareness is a key component in self-directed transcendent learning.

## Findings

What follows now is a series of scenes to act as vignettes of self-reflection and change. Each scene is set to illustrate how my research identity narratively draws on my personal and different journal entries at particular key points during my academic career. As the accounts show, there are brief descriptions of and reflections on episodes that represent the notions and contexts of my autoethnography.

### Scene one: Being a student in the field of self-directed learning

On 17 September 2013, the proposal for my doctoral study was approved. When the allure of relief had passed, I started to wonder about the actual process to follow thereafter – the writing of the so-called literacy chapters. The main research question was to determine in what way(s) do(es) understanding of identified metacognitive language and metacognitive networks contribute to theory-building concerning a student's metacognitive locale in teaching–learning. This was a promising contribution to the theory of metacognition. I later denoted the term of this theory as the *theory of metacognitive locale* (currently being investigated in a number of research attempts to validate the theory). I started out drafting ideas on how to combine what I have learnt thus far about the literature on theory and theory development, as this became the second chapter, a chapter to understand the nature of theory as a scholarly contribution. The following came to mind, as noted in my journal entry at the time:

> 'There are mainly four types of theories: (i) practice theories – which are intended for specific uses in particular contexts or locales, (ii) general theories – which act like standard theories in a particular field (as constructivism is to education), (iii) special theories with powers of overarching different contexts/locale and interest fields as well as theories of a more (iv) abstract, grand or meta-theoretical overlap – which can explain not concepts, but the relationship between general and special theories.' (Divan Jagals, journal entry, 19 August 2013)

What I picked up from this topology of theories is that theories serve particular functions in the conceptual framework, such as they classify, categorise, discover, predict and explain the concepts or conceptual framework. Later, I thought that introducing a new theory to the field would require a particular theory development strategy:

- Phase 1: Isolate the concept and describe it
- Phase 2: Explain how the different statements relate to one another
- Phase 3: Form a conceptual framework that can be used to predict the situation
- Phase 4: Did the prediction produce what you expected it to produce?

I then studied the work of Bohner (2017) to validate these phases, such as to identify the different components of theory. Through Bohner's explanation, I interpreted the keywords '...purpose, concepts, definitions, relationships, structure, assumptions and processs' (Divan Jagals, journal entry, 17 September 2017).

## Scene two: Researching and publishing in self-directed learning

The first two years after having obtained my PhD continued to be a season of critical change and academic rethinking. At this point, I noticed a number of conceptual matters at conferences, workshops and discussions with colleagues that hinted upon the idea of the community of scholarship:

> '… there were (i) photos from various places around the world, including South Africa, to illustrate the contexts of teaching and learning, (ii) an increased awareness in the intensity and meaningfulness in the articles [*I have been reading*], (iii) reflections on the questions and discussion on these papers, and [*in particular*] a focus on (iv) the trends and possible future directions of research in self-directed learning.' (Divan Jagals, journal entry, 08 February 2015)

Some research ideas that seemed valuable but difficult at the time include an understanding of:

> '… the language of thought, that which makes us self-regulate, metacognitive character – all deemed necessary to look into the metacognitive landscape of the individual.' (Divan Jagals, journal entry, 20 April 2015)

It seems, from a sketch illustrated in my notebook, that professional teaching is associated with SDL, because this involves:

> '[*T*]wenty-first century skills that rely on metacognition. The skills include language and geography of the mind.' (Divan Jagals, journal entry, 06 May 2014)

Other matters also considered to play a role in facilitating metacognition were noted as:

> 'Parents, socio-economic status, cultural discourse, research on social network analysis, blended learning as a major initiative in South African universities, problem-based learning, etc.' (Divan Jagals, journal entry, 14 August 2016)

The list of ideas that accumulate in the journals goes on and on, seeming to necessitate a broad kaleidoscope of the nature of SDL. Some hinted towards philosophical, theoretical and pragmatic assumptions. I have, for this reason, begun to highlight so-called *buzz words* that emerge from group gatherings, social discourses on SDL and faculty meetings. All these shed light on the need for and tripartite view on SDL (philosophy, theory and practice).

## Scene three: Supervision and presentation on self-directed learning

Soon after I had shared my ideas on conceptual and theoretical differences in SDL, I received invitations to supervise and present at conferences. Starting like most master's and doctoral students, I compiled a volume of guidelines for supervision, based on my own experiences and the experiences of others. I then managed to couple these guidelines with much of the existing literature on the topic. It seemed essential to create a series of confirmatory evaluations on student progress and the presentation of ideas:

> 'Provide teacher-students with an original lesson plan, and let them adapt it and redesign it according to their needs. Focus on the differences and similarities between the two versions.' (Divan Jagals, journal entry, 21 June 2017)

The scenes serve as vignettes to portray the context in which the findings are or can be established, though it is possible to string together a number of tools in any of these scenes. A defining focus on a series of ontological, epistemological and methodological tools will make the distinction between the tools clear, as attempted in Table 1.1.

The tools identified in Table 1.1 indicate my facilitated metacognitive awareness across various education research experiences as the vignettes show. The analysis highlights my educational research experiences, including the account of being a master's and doctoral student, an academic author and a supervisor of postgraduate studies. The mediating tools that facilitate metacognitive awareness to promote and understand SDL position my researcher identity as a subject in the subculture of SDL, whereas 'promoting self-directed learning' is the objective

**TABLE 1.1:** Overview of my mediating tools in SDL research as emerging from my research as activity system.

| Form of facilitating metacognitive awareness obtained from narrative | Emerging elements of research focus in SDL as sub-themes | Emerged mediating tools |
|---|---|---|
| Problem-based learning task, metacognitive reflective statement cards, visualising activities, worldview test, metacognitive prompts | Affect, meta-affect, imagination, Mathematics confidence, integrative worldviews, study orientation in Mathematics, cultural artefacts, personalised and adaptive learning | Ontological |
| Japanese lesson study approach, curriculum policy analysis, paradigm complexities | Socially mediated networks, theory of metacognitive locale, metacognitive ideologies, metacognitive transference, local instructional theory, ethical standards in curricula, spiritual–mathematical lens of ethnomathematics | Epistemological |
| Applying NodeXL for social network analysis, narrative focus group interviews, document analysis, model development for well-being | Metacognitive language, metacognitive networks, social roles in metacognitive regulation, metacognitive awareness, satisfaction with life and well-being | Methodological |

of the activity system. My researcher identity, in terms of the emerging definition of my research focus, developed continuously, with key features in the emerged mediating tools. These tools became important elements of establishing and acknowledging my own research identity in SDL. Table 1.1 also shows an overview of the profile of the mediating tools in my SDL research as activity system.

Across 10 years of educational research experiences, various forms of tools were applied to facilitate metacognitive awareness in quantitative, qualitative or mixed method studies. By implementing these tools, several elements emerged that indicate categories, sub-themes or themes in the findings. By aligning these elements to the CHAT, the following became clear: I (as a subject in the SDL research activity system) engage with and apply ontological, epistemological and methodological tools to facilitate metacognitive awareness to promote and understand SDL.

# Discussion

In this chapter, I took autoethnography as an opportunity to play my hand and tell my story (cf. Hayler 2012) to share educational research experiences in SDL. I did this towards defining a personal research focus in SDL. In doing so, I hope to contribute to other academics' understanding of the value and purpose of a personal research focus and consciously seeking the development of a personal research identity, particularly from a young academic's point of view. As I methodically engaged, both emotionally and cognitively, in the series of reflective accounts, I derived a research identity and defined a research focus across three research worlds, conceptualised as the ontological, epistemological and methodological locales of my research.

This autoethnography, therefore, delivers a reflection on the development of my research identity and defining a research focus as a young academic. Obstacles that challenge my development include the confusion amongst scholars on the meaning and theoretical synergy of the term 'self-directed learning'. This self-reflective act shows how educational research experiences interlude with cultural domains and how the inner and external context of a teacher and learner, student and scholar can mature.

Based on a variety of educational research theories (social constructivism, metacognition, zone of proximal development etc.), a series of tools was conceptualised to facilitate metacognitive awareness for my research purposes. These tools can be classified into the following three types of research tools. Firstly, ontological tools comprising any activities, tasks or mediators that create opportunities for reasoning and meaningful learning (Painho & Curvelo 2012:99) – these are usually task-based activities, such as problem-solving exercises and hard copy or virtual cases, that stimulate reflection. Secondly, epistemological tools, which involve any mediator that requires its user to reason and formulate hypotheses or make predictions, and could include religious and mythical aspects such as a set of signs, symbols, verbal utterances or gestures (Ijiomah 2005:78). Thirdly, methodological tools comprising methods or approaches to capture data on phenomenology, such as ethnography, narratives, social network analysis and observations (Maton et al. 2006:17). Conceptually, these tools can be considered so unique in their field that I think of them in light of Mouton's (2009) description of three worlds. When reflection is mediated by these tools, they can facilitate metacognitive awareness (see e.g. Jagals & Van der Walt 2016:157). As a result, meta-theoretical categories of awareness emerge, for example meta-affect, metacognitive knowledge and metacognitive self-regulation, which all correlate with SDL (Jossberger et al. 2010) and can promote the process of SDL (Knowles 1975:18) and aid in understanding the terminology of SDL (Van der Walt 2019:3).

## A focus towards promoting self-directed learning

Ontological tools considered to facilitate metacognitive awareness can, theoretically, be argued to facilitate metacognitive awareness to promote SDL (Jagals 2018). Some examples of ontological tools include the context, curriculum and other ontological tenets such as Mathematics problems that elicit affective experiences (such as Mathematics anxiety). These are primarily any means of generating empirical data regarding both metacognitive awareness and SDL. Other examples include the use of word problems to draw on learners' imagination and task-based reflections to allow for insight into participants' worldviews. Collectively, any mechanism, be it a teaching–learning tool or other cultural artefacts, that abides by the ontological contextual elements of education can be utilised as a research tool to facilitate metacognitive reflection towards promoting SDL.

Epistemologically, tools to promote SDL involve theory and the philosophical grounding of the use of instruments, research tools or other artefacts, designed especially (such as is the case with Japanese lesson study) to facilitate awareness. Epistemological tools that draw on social network analysis, theory of metacognitive locale, worldviews and ideologies and other means of benchmarks or international standards can serve as forms of knowledge or lenses to understand the ontological experiences.

Methodologically speaking, a variety of approaches, designs and data collection and analysis methods can be considered, although a stronger focus is intended on implementing a particular method or approach, as to become more familiar with its in-depth value for conducting research. Some examples include applying particular software packages (e.g. NodeXL) for social network analysis, narrative focus group interviews, document analysis or model development.

## A focus on my understanding and promotion of self-directed learning

As philosophy becomes more cumulative in modern times, the nature of SDL seems to be developing as well. There is, however, no clear philosophical framework for SDL, other than the theoretical constructs (and processes) governing its application. Ontologically, SDL could be understood in terms of the context and environment (e.g. socio-economic status) which differ (particularly in South Africa) from one region to another. It seems plausible that an African philosophy of SDL is required to understand this ontological nature. The epistemological nature of SDL suggests a need for teachers to be encouraged to develop, model and facilitate a SDL philosophy in their classrooms. A comprehensive summary of philosophies teachers tend to hold was given by Cox (2015). These include the Liberal course, Progressive course, Behaviourist course, Humanistic course and Radical course. These philosophies could be explored to determine their view on epistemologies such as socially mediated networks, theory of metacognitive locale, metacognitive ideologies, metacognitive transference and local instructional theory.

The methodological tools needed to understand SDL will be different from the focus on promoting SDL in the sense that they will be more theoretical and philosophical in nature. Self-directed learning, as a teaching philosophy (Burke & Reitzes 1991), can therefore be interpreted as self-direction for learning and is behaviour-oriented (in terms of promoting SDL) as well as instruction-oriented (in terms of understanding SDL).

These two views complement each other in the theory and praxis of SDL and are embedded within a personal identity to operate within the education environment. Self-directed learning can likely be adopted based on the researcher's personal values or preferences for the purpose(s) of research.

## In closing: Implications for my future research

The analysis revealed two fields of research focus that emerged in tandem. Firstly, analysis of the coherent narrative (based on journal and diary entries) indicated a focus towards promoting SDL, and secondly, the account also indicated an understanding of SDL. In essence, a reflexive analysis of my personal narratives on educational research experiences has 'enlightened' me as to my researcher identity within SDL as a research activity system and has also broadened my understanding of the meaning of SDL in practice. Possible limitations of this personal definition of a research focus in SDL include the thematic interpretations of other non-postmodern researchers of SDL on the depth and rigour of the role of personal narratives and reflexivity in developing a research focus. I end this reflective autoethnography with a vision: as a student, I stand in a scientific relationship with the object of self-knowledge.

Chapter 2

# Evaluating undergraduate students' self-directed learning experiences during research-based learning

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## Abstract

In this research we affirm that SDL is a natural capacity to learn for oneself without external guidance. For various reasons, including the emphasis on content-based education, this natural capacity has been stunted in the youth in South Africa. In an attempt to re-kindle this natural predisposition to learning and discovery, we tested our approach of research-based learning amongst a cohort of 100 undergraduate students in an Information Systems Research Methods and Philosophy course. We documented the efficacy of our approach through evaluating the experiences of 30 of these students based on their course diaries and reflections. Not surprisingly, the students reflected on their experiences in terms of the metaphor of a journey. We theorise that the students express a need for information based on a repressed need of not having the requisite skill or motivation to find out more about it for themselves. If the educators can encourage the students to explore these two needs for themselves, there is a high likelihood that they will stimulate the students' inherent capacity to learn. This approach develops the students' inner sense of self-direction and in the process forms their professional identity as researchers in the field or discipline.


**Keywords:** Self-directed learning; Research-based learning; Research-based teaching; Undergraduates; Self-directed research.

## Introduction

'I believe that God created the human soul capable of teaching itself by itself, and without a master' (Rancière 1991:139). These words were inscribed on Joseph Jacotot's epitaph in the Père-Lachaise cemetery on August 7, 1840, more than 100 years before Knowles coined the term SDL. Self-teaching is clearly not a new concept and can be equated to man's inherent drive to find meaning and purpose in life (Van der Walt 2019:4). As an educational concept, it has recently been formalised in terms of SDL theory construction (Knowles 1980). In his classical definition, Knowles (1975:18) sees SDL as a process where learners take greater responsibility for satisfying their own learning needs. Self-directed learning thus aims to develop learners' capabilities for learning and can be contrasted with a system of education that fosters rote memorisation, test-taking and the micro-management of lecturers (Vassallo 2013:571).

## Problem statement

*If* we assume that the ability to teach oneself is innate, then why do we need to be taught? One possibility is that the educational system is geared towards banking education (Freire 2005:256) and is reticent to change; where students are confronted with prescribed texts and reading for rote memorisation and assessment. This problem is not new and has been commented on by Aristotle (Soph. El. Aristotle n.d.:183b35) who refers to the practice by Rhetoricians of handing out speeches to be learned by heart; equating this to a metaphor of giving students shoes rather than teaching them the art of shoe-making. Likewise, modern educators prescribe and teach from textbooks and material that is the result of a process of research; yet they do not teach their students the actual process of research.

Fortunately, this problem is well recognised by adult educators who are challenging this 'banking' form of pedagogy with more self-directed approaches to learning (Jarvis 2010; Knowles 1984; Merriam, Caffarella & Baumgartner 2007; Pratt 1988). Yet, it appears as if these practices in adult education are not widely adopted in faculties other than education. Academics are appointed based on their disciplinary expertise where a minimum of a Master's degree in the discipline is required and not based on their qualifications to teach.[1] They may thus not be aware of the wealth of educational literature stressing the importance of developing self-directed learners. They tend to teach in the way

1. For example, in the Economics and Management Sciences faculty where this research was conducted, only 14% ($n$ = 19) out of 134 lecturers had a formal qualification in the field of education.

that they were taught (Oleson & Hora 2014:30). Ironically it appears as if they most likely taught themselves how to teach; that is, they were self-directed learners themselves (Berthiaume 2009; Shawer 2010). Once the educators realise this conundrum, they may identify in themselves the necessary capacities to teach their students to be self-directed (Kugel 1993). The aim of this research is therefore not to raise awareness of this conundrum, but to contribute to theories of SDL through research-based learning (RBL) experiences.

## Research problem

If SDL is a natural ability to learn, then why would students need to be taught how to become self-directed? This perspective is reinforced by concerns that one cannot 'direct' a learner to become self-directed (Mezirow 1997:11; Rancière 1991). Partially to blame are traditional pedagogies that tend to disempower educators and learners (Broom 2015; Van Der Walt, Potgieter & Wolhuter 2010). One of the arguments for facilitating SDL is that we require proactive teaching strategies to draw out these innate capacities in students who have low levels of self-regulation (Zimmerman, Bandura & Martinez-Pons 1992:664). Much like Jacotot's method, this approach to drawing out the learner's inherent abilities for SDL requires an expert facilitator who encourages active and collaborative learning approaches (Yeoh et al. 2017:596). Such active learning approaches do however challenge students who are accustomed to being spoon-fed (Du Toit-Brits 2015; Francom 2010; Grow 1991).

## Research question

Much research evaluates students' readiness for SDL (Gandomkar & Sandars 2018; Guglielmino 1978; Plews 2017; Visser & Van Zyl 2013). Less research examines how to facilitate SDL particularly in research or inquiry-based learning (Havenga 2016; Havenga et al. 2013; Steyn, Van der Walt & Wolhuter 2016). In addition, little published research exists on how students experience the SDL process (Levy & Petrulis 2012), especially in undergraduate Computer Science and Information Systems (IS) disciplines (Natsis, Papadopoulos & Obwegeser 2018; Rahman et al. 2017; Tams 2014; Wenderholm 2004).

Our research question is thus multiple in nature. Firstly, we wanted to test the approach of RBL as a strategy to transition students to SDL. Secondly, we wanted to know how students experienced this process and how we could improve our intervention for the subsequent years. Thirdly, we wanted to test the existing theories of RBL and SDL against our approach. The rest of the chapter is structured by first reviewing the conceptual and theoretical frameworks that informed this study. We then outline our teaching approach, the empirical method that we followed, the results of the study and a discussion of the key theoretical findings before we propose further recommendations.

## Conceptualisation of self-directed research

We recognise the conceptual and theoretical plurality in the extant literature with the term ‘self-directed learning’ (Candy 1991; Dehnad et al. 2014; Van der Walt 2019). Much of the research on SDL is centred around what it is (Knowles 1975; Knowles, Holton & Swanson 2005), why it is important (Guglielmino 2008), how it can be assessed (Guglielmino 1978; Williamson 2007), its effects on learning (Loyens, Magda & Rikers 2008; Yeoh et al. 2017) as well as evaluating the students’ knowledge and expertise with SDL (Yeoh et al. 2017). In higher education (or in formal learning environments) the emphasis is mostly on the selection and delivery of learning content, resources, learning goals and the evaluation of learning (the curriculum) by the educator.

This predetermination of learning outcomes binds the students to the educational system for their learning needs, goals, resources and evaluation, and likewise leads educators to succumb to the pressures of the educational system in prescribing and evaluating knowledge competencies as opposed to learning skills (Bentley, Habib & Morrow 2006; Harland 2017). This places little freedom on the students to become self-directed in their studies except for how they are going to plan and manage their learning activities in order to meet the course objectives (Biggs 2012).

Less emphasis is placed on the learning process or strategies that students and educators follow in the process. In limited cases, courses are included to strengthen learners' skills in learning methods. To transform this crisis, a strong emphasis needs to be placed on the learning strategies that students use as well as shifting the locus of control to them. Ideally, the emphasis should be on how to structure the class and course environment so that students have greater control of their own learning (Garrison 1997). This strategy is ably encompassed in the modern concept of SDL (Knowles 1975; Smythe et al. 2008).

## Self-directed learning

According to Knowles (1975), SDL can be defined as:

> [*A*] process in which individuals take the initiative, with or without the help of others, to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes. (p. 18)

Some authors suggest that the lack of coherence in SDL theories stems from the conceptual confusion around defining SDL (Arkan & Sari 2016; De Beer & Gravett 2016; Van der Walt 2019). We heed the advice of Van der Walt (2019:16) to build on Knowles's definition of SDL as 'a dynamic, non-deterministic process in which learners and teachers are intrinsically involved as responsible and accountable adults'. These concepts are represented in Table 2.1 when juxtaposed according to who directs the learning:

**TABLE 2.1:** Comparison of learning needs.

| Concept | Learning element | Self-directed | Other-directed |
|---|---|---|---|
| **Theory and practice** | *Which* kind of learning | Andragogy: art and science of helping adults learn. | Pedagogy: art and science of teaching. |
| **Learning needs** | *What* to learn | Identifying own learning needs, selecting and enrolling in courses, modules or subjects regardless of institution or degree purpose. | Structuring of degree programmes, coursework, modules, subjects, prerequisites by academics or administrative staff. Main emphasis of content-led and banking education. |
| **Learning goals** | *Why* to learn | Learning motivation engendered by personal interest. | Goals are determined by the course outcomes or lecturer's determination. |
| **Learning resources** | *With* what to learn | Freedom to choose learning resources such as web, articles, books etc. Can be online or offline. | Prescribed textbook, reading list and limitations of sources. |
| **Learning strategies** | *How* to learn | Free to learn in a way that learner has become accustomed to. | Not normally prescribed in HEI, except for academic development courses. |
| **Evaluation** | *How* to evaluate | Learner determines when he knows enough about the subject or method of learning. | Courses require summative and formative assessment to evaluate progress. |

*Source*: Adapted from Knowles (1975:18).
HEI, higher education institution.

From this synthesis, we contend that educators need to balance their learning interventions based on the teaching need. They do however need to be aware of the need on how much control they exercise to satisfy that need as opposed to the students exercising their own control. From Table 2.1, one can infer that if the learner identifies a need to learn something new (i.e. what to learn) and enrols in a course, it is expected that the educator becomes responsible for satisfying that need. Likewise, the students' learning goals (why to learn) may be intrinsic and diverse, yet often the course outcomes are predetermined and static. The choice of learning resources (with what to learn), for example, human or material resources such as textbooks, journals, websites or articles also needs to be balanced against the needs of the learner versus the needs of the curriculum or course. Learning strategies (how to learn) are not prescribed in courses, and students are left to use whatever strategy they are familiar with. Finally, assessment of learning (how to measure) is mostly left for the educators to determine, based on pre-agreed standards. In SDL, the learners are responsible for determining when they know enough about the subject or topic of interest.

## Research-based learning

Research-based learning is an active learning strategy where the students conduct actual research in authentic environments (Brew 2010; Elsen, Visser-Wijnveen, Van der Rijst & Van Driel 2009), and one that has significant potential in developing self-directed learners (Elsen et al. 2009; Griffiths 2004). Research-based learning is considered to be one of the highest and the most complex form of the active learning strategies, together with inquiry-based learning, eclipsing experiential learning, exploratory learning, action-oriented learning, problem-based learning (PBL), project-based learning (ProjBL) and case-based learning (Wildt 2011). Research-based learning has a number of synergies with inquiry-based learning, experiential learning and PBL (Shaban, Abdulwahed & Younes 2015:21). Research-based learning emphasises the practicing of research, but can be classified as part of the broader sphere of inquiry-based learning (Shaban et al. 2015:21). Research-based learning is also problem-based, that is, one researches a particular problem or research question; however, it is not the same as PBL which emphasises design and implementation of a chosen solution for a particular problem (Shaban et al. 2015:21).

There are many synergies between RBL and SDL, as both concepts draw on autonomous active strategies of inquiry. Yet the application (*which* kind of learning), the learning goals (*why* to learn), the learning strategies (*how* to learn) and the outcomes (*how* to evaluate) are quite different between these two concepts as represented in Table 2.2.

Both SDL and RBL are directed at learning (new) knowledge; however, SDL is based on the interest of the students, whereas RBL is based on the interest of the broader research community.

**TABLE 2.2:** Comparison between SDL and RBL.

| Learning element | SDL (Knowles 1975:19) | Research-based learning | Source |
|---|---|---|---|
| **Which kind of learning** | Andragogy: The art and science of helping adults learn. | Research: A systematic process of investigation with the aim of advancing knowledge within the field of inquiry. | (Griffiths 2004:714) |
| **Where applicable** | Nurturing the learner to grow in their own capacity to learn for themselves. | Strengthening the learners participating in the research process. | (Elsen et al. 2009:71) |
| **What to learn** | Identifying own learning needs, selecting and enrolling in courses, modules or subjects regardless of institution or degree purpose. | Teaching is based around research activities rather than prescribed content. | (Griffiths 2004:722) |
| **Why to learn** | Learning motivation engendered by personal interest. | Active construction of complex knowledge by the students. | (Healey, Jenkins & Lea 2014:16) |
| **With what to learn** | Freedom to choose learning resources such as web, articles, books etc. Can be online or offline. | Although some readings can be provided by the educator such as in research-led learning, the student is coached to use academic, peer-reviewed resources. | (Uys & Chigona 2018) |
| **How to learn** | Free to learn in a way that the learner has become accustomed to. | Need to follow a systematic process of inquiry that is acceptable to the field of inquiry. | (Griffiths 2004:714) |
| **How to evaluate** | The learner determines when he knows enough about the subject or the method of learning. | Dissemination of research essays and articles that are evaluated by experts and peers. | (Elsen et al. 2009:74) |

*Source*: Adapted from Knowles (1975:19).
SDL, self-directed learning.

Neither RBL nor SDL are geared towards the teaching of content; however, there is more (formal) teaching involved in RBL, where the educator's aim is to develop the students' competencies in research and not merely in general learning and inquiry. The students are also free to choose specific learning resources (articles, books etc.) with both approaches; however, the rigour and relevance of these articles are much more stringent in RBL. Finally, SDL outcomes are evaluated by the needs of the learner, whereas RBL outcomes are evaluated based on the standards of the broader academic community, which may be simulated in the classroom environment for educational purposes (Uys & Chigona 2018).

Research-based learning has become synonymous with undergraduate research, as there is less teaching and more supervision of research at postgraduate levels (besides the compulsory research methodology courses) (Healey & Jenkins 2018). The emphasis with teaching undergraduate research is to teach the discipline-specific forms of knowledge creation and methods, aligning with staff or departmental research interests and producing outputs that are typical of the field (Healey & Jenkins 2009:23). The typical characteristics of an undergraduate research process require that the students read scientific literature in the field, design some aspect of the research project, work independently or in groups, own the process, explore meaningful and relevant research questions, aim to produce significant research findings and learn to present their work to their peers and/or the scientific community (Healey & Jenkins 2009:24).

Prior research indicates material benefits of RBL such as students' improved ability to put theory into practice, improved creativity and critical thinking skills as well as greater problem-solving and communication skills (Elsen et al. 2009; Griffiths 2004). Natsis et al. (2018:357) report that changing the role of the students from consumers to producers of knowledge 'promotes deeper engagement with the course material and provides valuable cognitive gains'. Integrating research in the curriculum also engenders SRL, peer-learning and help-seeking strategies in students. This approach also develops their technical skills of 'reading and analysing academic literature, writing scientific papers, collaborating with others and communicating effectively about their work' (Natsis et al. 2018:357).

Research-based learning also allows much greater scope for the students to determine their own learning needs than traditional pedagogies; however, not as much as with SDL. In RBL, it is up to the student to explore the topic in greater depth, even though the lecturer or discipline might determine the initial research problem or topic of inquiry. Central to the concept of RBL is that learners (not the lecturer) conduct the research on the topic and share their revised understanding with the broader community or alternatively with their classmates or lecturers or institution (Shaban et al. 2015). In this way, RBL places the student at the centre of the research process, as well as fostering the development of self-directing learning capabilities and developing the competencies to learn more about the discipline or field. It is our view that RBL is essentially the practice and teaching of the scientific process of research (Poppi 2019:41) and has much in keeping with humans' natural desire to understand and control the world around them (Lear 1988).

## Research-based teaching

Even though the ability to learn without the aid of a teacher is a natural human capability (Dewey 1910; Knowles 1975), there is a growing awareness that adult learners are not necessarily effective in this process and that formal facilitation is necessary to enhance the learners self-directing capabilities. It is critical to note that the emphasis with such an approach shifts from the teaching of course content, to one of facilitating the (self-directed) learning process. Research-based teaching (RBT) is the corollary of RBL and is an approach for teaching students to become independent (self-directed) researchers (Griffiths 2004). According to Stenhouse (1979:1), 'Research-based teaching is more demanding than teaching a defined set of objectives-based instructional content which in reality is teaching a rhetoric of conclusions'.

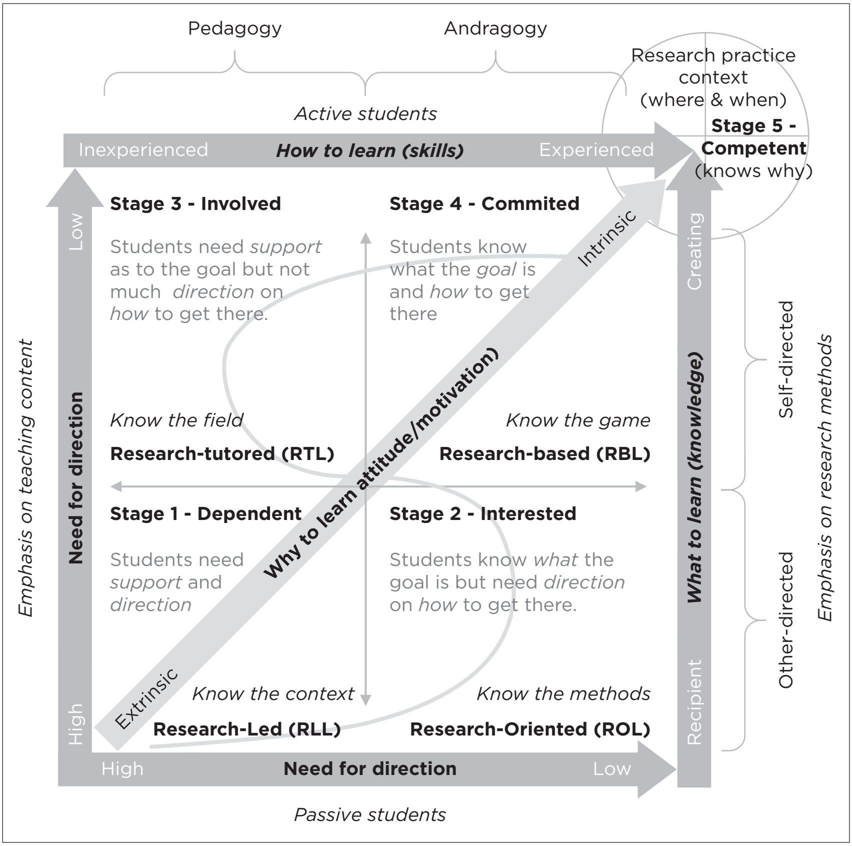
Research-based teaching is founded on processes of knowledge creation, rather than on the acquisition of subject content knowledge (Griffiths 2004:722). This is achieved by integrating 'the experiences of staff in processes of inquiry' together with 'student learning activities' and minimising the 'division of roles between teacher and student' (Griffiths 2004:722). The aim of RBT is to 'induct students into a "community of scholars"', for them to research a topic of interest in the discipline or institution, and present the result of their research as a presentation, publication and/or reflection of the research process. Research-based teaching also emphasises research outputs such as conference papers or journal publications (Tams 2014:177). In the process, 'the students are exposed to new concepts, develop new skills and gain greater epistemological access in the discipline' (Uys & Chigona 2015:101). In addition, RBT 'promotes currency in the discipline, intellectual growth, and student/faculty relationships' (Tams 2014:177).

Mentoring is also an essential aspect of enhancing students' creativity with undergraduate research (Tams 2014). Creativity is emphasised because formal hypotheses and new ideas are central to scientific research and effective mentoring helps to guide students through the research process in an autonomous manner and helps them to cope with the stressors of research and undergraduate life. Tams (2014:174) outlines a four-step process for applying the phases of mentoring (Malachowski 1996:91) as an approach to developing research skills, namely, initiation, cultivation, transformation and separation. Through effective mentoring (Tams 2014:176), educators are directly influencing their students' career choices as well as attracting them into more academic settings. The approach of mentoring also leads to a greater awareness of student interest and concerns that help educators in improving their classroom practices.

## Theoretical model

Griffiths (2004) teaching-research nexus (TRN) model has become the de-facto model for representing the link between teaching and research at an undergraduate level (Elsen et al. 2009). This model represents two axes of the TRN, with the horizontal axis emphasising teaching versus research, and the vertical axis indicating teacher-directed learning versus SDL. This results in four quadrants for theorising about the teaching of research as illustrated in Figure 2.1, namely research-led learning (RLL), research-oriented learning (ROL), research-tutored learning (RTL) and RBL.

According to Elsen et al. (2009:71), RLL is exemplified by the traditional teaching of core curriculum content. Research-oriented learning encompasses the teaching and learning of research methods or methods of learning. Research-tutored learning is envisaged as the critical evaluation of recent research outcomes such as journals and conference proceedings. Research-based learning refers to the practice of learning to research by doing. Research-based learning therefore has great synergy with SDL, and the classic TRN model was expanded to incorporate these SDL aspects. The aims of an SDL approach to teaching research should be to transition the learner from a teacher-directed curriculum towards a learner directed research practice. Much research has been conducted at the intersection of the teaching and research axis (Elsen et al. 2009; Healey 2005; Jenkins & Healey 2005; Lubbe 2015; Obwegeser & Papadopoulos 2016; Trowler & Wareham 2007). Some work has been done in terms of the TRN and inquiry-based learning (Levy & Petrulis 2012). Yet there are limited examples at the intersection of




*Source*: Adapted from Elsen et a`l. (2009), Grow (1991) and Pratt (1988).

**FIGURE 2.1:** Stages of self-directed research.

teacher versus student direction (the horizontal axis in Figure 2.1) in terms of RBL.

In order to illustrate this link between student and teacher direction, we extended Elsen et al.'s (2009) model of the TRN by drawing on adult SDL concepts (Grow 1991; Pratt 1988). Grow (1991:128) proposes a model of SDL that depicts this process. This staged model 'proposes a way (that) teachers can be vigorously influential while empowering students toward greater autonomy'. We then mapped the stages of Grow (1991:129) to the andragogy or pedagogy model of Pratt (1988:167) and the TRN of Elsen et al. (2009:72) to develop a revised theoretical model for self-directed research as represented by two axes of direction (what to do or learn) and support (how to do it). The vertical axis represents the link between teaching and research and the horizontal axis the link between educator and student-directed research. We named the quadrants based on the work of Grow (1991) as well as the staged model of skill acquisition from Dreyfus and Dreyfus (1980:7–14). Consequently, this model represents five stages of research maturity, namely, (1) dependent, (2) interested, (3) involved, (4) committed and (5) competent, concepts that will be explained in the following section.

## Stages of self-directed research

Our teaching approach intends to transition students from a level of dependency on the educator, through teaching them more about the field or discipline, to a level of independency where they want to find out more for themselves on what they need to know and how to go about it. This process can be explained with reference to this five-staged model of self-directed research, and discussed in more detail in Uys and Chigona (2015):

- Stage 1: Dependent. The students are still dependent on the educator to teach them more about the subject and the process of research. The students are typically not very excited about the prospect of learning something new and in some ways feel coerced into doing research, for example, it is a course requirement. The most appropriate teaching style is the traditional teaching or lecturing approach with the lecturer assuming the role of authority or coach with immediate feedback (Grow 1991). The aim at a RLL perspective is to familiarise students with the fundamentals of their field or discipline through reviewing existing research outcomes (Elsen et al. 2009:79). This could be done by means of seminars, tutorials or prescribed readings on the topic or field of research

(Elsen et al. 2009; Uys & Chigona 2015). The process operates first by focusing the students' interests inward to learn more about themselves and their context. This stimulates some interest as people are naturally interested in themselves.

- Stage 2: Interested. The students may show some interest in the subject but need support on how to find out more about the topic. The students are exposed to methods in the discipline much as in a ROL approach. The aim at this stage is to teach the students how to do research based on methods that are advocated by textbooks or publications in the discipline or institution (Uys & Chigona 2015). The teaching strategy is the typical 'research methodology course', that would include practical activities such as the use of library databases, developing search parameters, finding suitable articles, reviewing and summarising these as well as writing of seminar papers and presenting them to their peers (Uys & Chigona 2015). At the same time, students are learning more about the research facilities of the institution, developing their writing skills and learning how to use ICTs and library databases in their research. The style of teaching is motivational or guiding, and the format is inspirational lectures plus guided discussions. The emphasis is on goal setting and learning strategies and gaining involvement in the process.
- Stage 3: Involved. At Stage 3, the students are actively involved in the learning process, that is, they are what we call 'good students', but may need more direction in terms of the subject or content of the discipline, that is, pointed to interesting or related theories, methods or 'hot topics' in IS. The aim at this stage is a critical evaluation and discussion of the most recent research in the discipline or field through the writing of research essays, group projects or seminar presentations (Elsen et al. 2009; Grow 1991; Uys & Chigona 2015). The teaching approach is RTL and is comprised of critical discussions led by a facilitator as an equal.
- Stage 4: Committed. At Stage 4, the students are committed to the subject and know how to learn more about it. The aim

at Stage 4 is centred around the RBL approach, of students conducting authentic research in the field discipline, that would result in a peer-reviewed research output (Elsen et al. 2009). The teaching approach is similar to postgraduate supervision; however, students would require more guidance and structure at an undergraduate level on pre-defining the research project, responsibilities of contributors and areas of specialisation (Uys & Chigona 2015, 2018). Formal lectures may be dispensed with, and interactions take the form of an apprenticeship, writing of essays or assignments, dissertations, individual work or self-study (Grow 1991). The role of the educator is one of consultant, delegator or supervisor. Once students reach Stage 4, they are already starting to learn the rules of the game, and are practicing to be researchers. They do such things as compiling research proposals, funding grants, sourcing ethical clearance, sponsorships, printing, interviewing, surveying, literature reviews, writing etc. They are still not fully-fledged researchers at this stage as they are practicing under the auspices of the lecturer and are given specific areas of research, roles and responsibilities to fulfil.
- Stage 5: Competent. At Stage 5, the students participate in the practice of research and are able to contribute to the body of knowledge in the field or discipline. At this stage, they are seen as competent researchers in both the subject and the process of research, as experts in their field, and are able to both practice and communicate their research. The typical profile at this stage is one of authority or expert. Even though this stage is not represented by Elsen et al. (2009:79) in their model, they indicate this limitation by stating that 'finally, a course can concern the research of academics in the institute, or research that was done elsewhere; however, this distinction cannot be indicated in the two dimensional design'. (p. 79)

Thus, this model of self-directed research outlines the stages of learning that a student may transition through from being a dependent student to becoming an independent researcher. The style of teaching depends on the learner's or curriculum needs for that stage as will be explained during the discussion section at the end of this chapter. The next section presents our teaching approach based on this framework.

## Our teaching approach

The primary approach that we utilised for introducing the students to self-directed research was by following the stages of self-directed research as outlined in the previous section.

For Stage 1, in line with the approach of Millar and Saddington's (1993), the cohort of 100 students were (1) provided with required reading of key texts in the discipline, (2) given assignments that have clear goals but unclear objectives so that they needed to 'grasp in the dark' for solutions, (3) formed them into 20 groups of 5 students to enhance cooperative learning, (4) tasked them with regular reflections in order to instil an intrinsic approach to learning, and (5) implemented role alternation where the lecturer and student roles change.

For Stage 2, workshops on information literacy (Noll & Brown 2019) and academic writing (Clarence 2011) were provided at the start of the semester. This was deemed necessary in the context of South Africa, where many students are first-generation students and where English is a second or third language for most students (Bharuthram 2012). Their experiences were captured in a reflective diary and submitted for assessment at the end of the semester which was subsequently analysed in terms of our research question.

Stage 3 was structured around the preliminaries of the research process, including conducting literature reviews, developing the theoretical framework, training on using the library databases and writing skills. For Stage 3, we also provided a series of research assignments that led the students through the research process. These were (1) personal introduction, (2) reflections on student life, (3) conducting empirical observation, (4) research on a selected list of theories in IS, (5) research on selected methodologies in IS, (6) a literature review and summary assignment, (7) the final project report and article, and (8) finally a personal reflection that outlined their role and learning during the course.

For Stage 4, we set a challenging *goal* for the students to conduct a quantitative survey of more than 2000 students on their 'smartphone application usage amongst students at a South African University' (Uys & Chigona 2018). The students were divided into 20 groups of five students each. Each group was given a different role, and a management group was established to coordinate all the group activities. We appointed a research director, a secretary, a coordinator for the social events, someone in charge of the prize draw and sponsorships, a reference manager and someone responsible for the statistics and/or data capturing. We also pre-selected the manager for each research group. We also introduced management meetings, where the leaders and secretaries of each group met as a larger group.

Stage 5 was never reached with this cohort, even though the intention was to publish a research paper from the findings of the students. Students at an undergraduate level appear to have limited interest in publishing an article, and the responsibility for this thus falls on the lecturer. This was the approach that we followed in year one of the course, where the lecturer produced a conference paper collaboratively with one of the groups (Uys et al. 2012).

Overall, the students were responsible for every stage of the process, and even though the lecturer attended a few of the 'management meetings', he did not provide much input into the decisions that were made by the students. In order to aid the students recollection and reflection of the events during the semester, we asked them to keep a diary of what they did as well as providing them with a framework for reflection (See Table A2.1 in the Appendix) that is derived from Aristotle's elements of circumstance (Sloan 2010:236). These reflections were then analysed according to our conceptual framework.

## Research method

The research reported in this chapter is part of a broader longitudinal case study (Swanborn 2010) of conceptualising a research curriculum in undergraduate IS. The aim of this investigation was to empirically evaluate how students experienced our teaching approach of developing them as self-directed learners. The sample was obtained from a group of third year IS students at a higher education institution. The course was a third-year course on research methods and philosophy (IFS352) in IS. This is also one of the few higher education institutions (HEIs) in SA that offer an undergraduate course in research in IS (Uys & Chigona 2018). This case examined the third year that this course was run. We collected our data from a selection of 60 reflective essays (out of 100) that the students wrote as part of the course. The selection was based on a strategic sampling of the group leaders and two students per group. Ethical clearance was obtained from the University where this study was conducted. Students were asked to complete informed consent forms in which they provided permission to use quotes from their reflections for this study. Confidentiality was maintained by using the students' initials only. From the 100 reflections, 60 were selected for further analysis based on a strategic sampling of the group leaders and two students per group. These reflections were sanitised and loaded in NVivo 12 for analysis.

### Analysis of reflective diaries

Reflective diaries are a useful source of information on a person's thought processes, both for educators and for the students (Glaze 2002; Moon 2014; Wallace 2011). Reflective diaries add rigour to the process of reflection, as one tends to forget distant events, as well as providing a rich source of reflections for analysis (Glaze 2002). Students were instructed to keep diaries at the start of the term in line with Moon (2014).

> 'The lecturer has been stressing the reasons that it is important to keep a *diary* of everything that happens in the module, as well as mapping out our progress and methods etc. We then were assigned to submit an 'extract' of the said *diary* to the lecturer in order to show our progress, as in; where I am in Research towards my final exam, What I am having success with, How I feel about myself, How I feel about my group members, What I have learnt so far about myself in the course, and finally – What I have learnt so far about others in the course.' (NNN, student, 14 June 2013)

We performed two rounds of coding and one for the presentation of our results (Saldaña 2010). These were (1) categorising the reflections (Matthews 2009) with reference to Aristotle's categories (Categories Aristotle n.d.), (2) analysing the topics (Krabbe 2013) with reference to Aristotelian Topics (Topics Aristotle n.d.), and (3) presenting the results using Aristotelian dialectics (Krabbe 2013) as illustrated in Figure 2.2. For more in-depth clarification of the analysis procedure, please refer to the research methodology section in Uys (2018:184).

Aristotle's Categories expresses 'what' something is (i.e. its essence), 'how' it is (its quality), 'how' much it is (its quantity), 'where' it can be found (its relation to other things) and also *how* it comes into being (Cat. Aristotle n.d.:103b20–27; Matthews 2009). These categories were provided to the students as reflective prompts for their diary entries in terms of reflecting on their experiences in this course. See Table A2.1. in the appendix for a description of these prompts. These prompts are widely used for evidencing reflections (Race 2002), in a somewhat modified form (Driscoll 1994; Revans 1980) and for episodic event reporting (Five W's 2019) and are founded on Aristotle's elements of circumstances (Sloan 2010).

In our analysis, we first auto-coded the corpus of reflections for the terms 'How' (887) and then identified the term 'experiences' (345) as a subset (union)[2] after the first round of coding to arrive

2. The numbers in brackets indicate the frequency of occurrence of the text in the corpus of data.

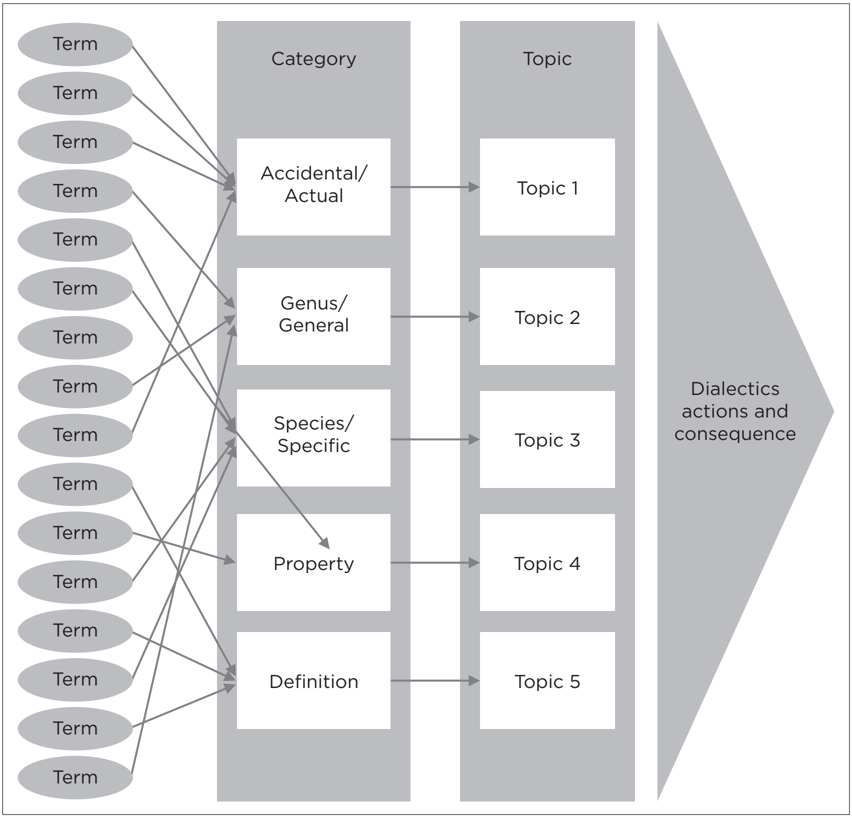



**FIGURE 2.2:** Data analysis procedure.

at the category of 'experiences'. Once we had identified the key categories for both teaching and learning approaches, we grouped all the quotes under each term, that is, all the quotes for 'how' were arranged according to the central term that is, 'experience', 'direction', 'track', 'line', 'step', et cetera. We did this by exporting all the sentences containing the central term, that is, 'experience' to Excel and then grouping them around the central term using a macro. This allowed us to examine each quote for the terms that precede it and those that follow each term. We then coded the action terms (verbs) that belong to 'How' based on Aristotle's Topics (Studtmann 2013). Topics are seen as common subject matter or 'places in mind' from which one can construct or defend arguments (Tallmon 1994). Topics (Leff 1983) relates the definition of something to general opinion on the matter. These topics are represented by past cases, examples or definitions (Aristotle n.d.:1403b12).

Our third round of coding analysed the topics in terms of Aristotelian dialectics. Dialectics has its roots in the practices of Socratic questioning and was further developed by Aristotle into a comprehensive system of reasoning. In modern qualitative data analysis (Charmaz 2006:63–66, 111), dialectics is also referred to as 'theoretical coding'. Theoretical coding is achieved through coding for the six C's namely causes, contexts, contingencies, consequences, covariance and conditions. In our case, we reverted to Aristotle's method of analysis (Analytics Aristotle n.d.) for establishing the line of arguments, that is, the causal sequences. Aristotle's lines of arguments are comprised of five steps (Aristotle n.d.:Bk. I, ch. 13), namely, (1) the securing of propositions, (2) distinguishing the number of senses, (3) the discovery of differences, (4) the investigation of likeness and (5) the defining of the terms.

## The students' experiences

We first coded the term 'experience' from the students' diaries in order to understand their in-vivo definition. From the term experience, we coded the related minor categories of 'direction', 'track', 'step', 'path', 'stage' and 'way'. This informed the broader topics of 'approach' and 'course' that were then further defined. This analysis revealed the following sequences that the students used to describe their *journey* towards *self-direction* in research.

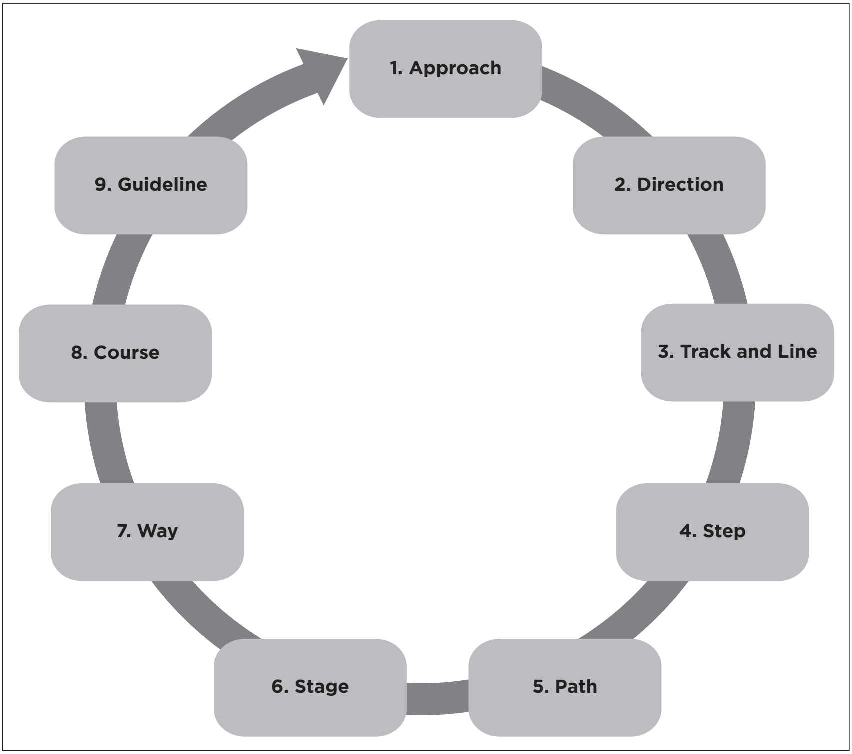



**FIGURE 2.3:** Cycle of self-directed research.

The students experienced their learning as a sequence of steps or stages progressing throughout the research process. Please refer to Figure 2.3 for the illustration of the sequential process and to Table 2.3 for the definition of each of the coded steps. The frequency of the term as coded in the corpus of data is indicated by the symbol *f*.

The following quoted extracts highlight a selection of these reflections that were coded in order to derive the sequences and definitions in Table 2.3.

**TABLE 2.3:** Students' experiences.

| Sequence | Term | Definition (In-vivo) | *f* |
|---|---|---|---|
| **Teaching approach** | Encouraging | The process of *supporting* and *directing* the students to take action for themselves. | 90 |
| | Direction | *Guidance* or learning on how to *approach* things. | 250 |
| | Guidance | A way to learn *how* to deal with the unfamiliar. | 165 |
| | Way | The *direction* in which students need to go (i.e. where) and the manner (i.e. how) they should proceed i.e. their *approach*. | 321 |
| **Approach to learning** | Approach | *How* students need to go about *doing* things. | 164 |
| | Track | Choosing the correct *direction* in which one wants to go. | 42 |
| | Step | A way to highlight the direction (*path*) one needs to take in doing something. | 92 |
| | Path | The actual route to follow in order to reach your *destination*. | 24 |
| | Stage (of Journey) | *Sequence* to follow in order to complete a task. *Stage*' as being a stage of their lives, their careers, education, the course, the assignment or even their stage of learning. | 57 |
| | Stage (Destination) | *Sequence* to follow in order to complete a task. *Stage* as being the destination or platform i.e. performance or graduation. | 57 |
| | Course | A *sequence* of tasks and activities that are performed in order to learn new things. | 533 |

*f*, frequency of the term as coded in the corpus of data.

'Therefore, the *approach* was to understand and to learn how to research and how to benefit from each process.' (LM, student, 14 June 2013)

'I learned about IS philosophy, African philosophy, different schools of thought for research and just how to *approach* certain aspects of the course.' (QN, student, 14 June 2013)

'The research process includes all the *stages* involved in the completion of the technical *report*. The various *stages* include getting information, sorting the information, reading, analysing, constructing the technical report, referencing, evaluation and re-adjustment. The research process is long and draining, mentally and physically.' (LEM, student, 08 June 2011)

It is of course possible that different students progress at different speeds (pace) along the course and that not everyone would reach the final stage at the same time. This is true of most life experiences and is recognised in HEI as the discrepancies in quality of assignments and in the resultant marks:

> 'Everything that I have learnt about IS Research I had to teach myself. I often enjoyed not being told what to do; it gave me a sense of *finding my own way*, although when things remained without *direction* it became extremely frustrating.' (STS, student, 14 June 2013)
>
> '*Guidance* is given to student researchers through interactions from the lectures, *direction* and advice was given on *what* to research and *how* to research.' (TL, student, 14 June 2013)

One would expect that the students would have experienced the course as different stages of learning according to the theoretical model of staged self-directed research. This was however not the case even though the course (assignments and discussions) followed the staged approach. For the students, the (definition of a) course essentially became 'A *sequence* of tasks and activities that are performed in order to learn new things'. Designing a research course for SDL therefore requires the laying out of this learning path for the students and guiding learners along the way.

## Results

It is important that the educators tailor their interventions to the learners' particular needs at the time, else they may encounter resistance (Millar & Saddington 1993; Pratt 1988). Based on Pratt's (1988) SDL model, the educators can support learners in four main ways, namely:

> [*They*] must, in turn, be clear about *what* is to be done (goals and tasks), *how* it is to be done (structure, sequence and pacing), *why* it is important or relevant to the learner (purpose), and on what basis the learner's progress will be *assessed* (how they will be evaluated). (p. 168)

This is illustrated by our theoretical model in Figure 2.1. Based on this model, the educator should fulfil four basic needs, namely, the need for direction (what), the need for support (how), and the need for motivation (why). The fourth need (so what) refers to the outcomes or destination. These four needs relate directly to learning's primary tenets; namely, knowledge (i.e. what learners need to *know*), skills (i.e. what they should be able to *do*), and attitude (i.e. why they need to do it) (Clark 2012). The fourth need determines the outcomes or change in behaviour. We discuss each of these needs in more detail in the subsequent section.

## Need for direction (what to learn or do)

Firstly, the educators need to fulfil the students need for direction. For Pratt (1988):

> Learners need direction when they lack the necessary knowledge or skills to make informed choices-when they are unable to be self-directed; here they must rely on others who are better informed. (p. 166)

Students may express this need as a need for more information. This need for information may repress a deeper need for where to find information (how to) or its importance (why to). If educators provide for this need directly by giving the students the required information, they foster a dependency in the students, that is, by giving them a fish. Thus, the educators need to transition students from a high degree of dependency to some degree of independence so that they can explore the required material on their own, that is, teach them how to fish. The educators can provide for this direction by setting clear goals, tasks, structures, and evaluation (Pratt 1988). We found that, if educators provide the detailed steps that the students need to follow, the students do not learn as much as when they find their own direction. As one of the students' reflected:

> 'We were given assignments where we needed to do specific research on different topics. We were not always given *direction* and this helped me to think out of the box and take initiative which is important in the world today' (CC, student, 14 June 2013).

However, not all the students, especially the dependent learners (with reference to Stage 1 of our theoretical model) valued this approach. The literature has raised concerns about minimally guided approaches and emphasises that instruction should focus on 'giv[ing] learners specific guidance about how to cognitively manipulate information in ways that are consistent with a learning goal and store the result in long-term memory' (Kirschner, Sweller & Clark 2006:8). Our findings indicate that this applies mainly to Stage 1 learners as this stage emphasises students' ability to recall information rather than how to find the information in the first place where educators need to provide intrinsic guidance. The other stages do require less guidance by the educator so that the students can learn to guide themselves. Educators need to find a balance between providing too much structure for the students to do their assignments versus providing them with the direction that they need to take. This can be exemplified to booking a tour guide to visit a foreign city as opposed to buying a guidebook or using the Internet to plan one's visit for oneself.

## Need for support (how to learn or do)

Secondly, educators need to fulfil the students' need for support. For Pratt (1988:166), this 'need for support comes from a lack of commitment to the goals (motivation) or lack of confidence in one's ability to accomplish the goals'. When learners lack confidence in their own abilities to find the information (how to) or they have no interest in the course (why to), then it becomes more difficult to provide them with the necessary support (what to do):

> 'The way he *approached* this module was to introduce us to *how* the working environment is, *how* they expect you to know *how* to accomplish a task without direction.' (RM, student, 14 June 2013)

In this course, we provided the students with indirect support, for example, we formed students into groups, established a management team with a manager in each group, appointed tutors and postgraduate students to assist the groups, and invited other lecturers, the writing centre, and librarian to provide them with feedback and workshops. As one of the students reflected:

> 'We were also placed into groups and these groups would basically be our support structure in this course. We had to learn *how to manage* and deal with each other which added to the experience of an unconventional class.' (QA, student, 14 June 2013)

As such, the students experienced their groups as their support structures and went to them for help or assistance when required. Even though the students realised that the lecturers gave them the assignments, they had become accustomed to asking their lecturers for the required support. When the lecturer did not readily provide such support, the students needed to find other means of support.

## Need for motivation (why to learn or do)

Thirdly, the educators need to fulfil the students' need for motivation or relevance. A lack of motivation manifests in the students' lack of commitment or confidence in their ability to achieve the course goal. As Pratt (1988:166) emphasises, learners need support at this stage, when they 'see achieving goals as neither to their benefit nor to their detriment'. As we see it, the problem with motivation is that it can either be intrinsic or extrinsic (Ryan & Deci 2000). Self-directed learning focuses on developing intrinsic motivation; it does not require an educator as a cheerleader to push and extrinsically motivate students because, when the educator is not around to motivate the students, the students' progress towards the goal would slow down and stop. Educators can teach students to become self-motivated through phasing out praise, which fosters dependency, and phasing in encouragement, 'which builds intrinsic motivation' (Grow 1991). As CC reflected:

> 'The lecturer *showed* us all a lot this semester and taught us how not to always depend on people to give you *direction* because you may not always have it in the working world.' (CC, student, 14 June 2013)

We found that students are willing to participate in the activities that educators give to them if they can see the value in the learning experience or believe in the educator's abilities to lead them, no matter how ambitious or unreachable these goals might seem. As KK reflects:

> 'The lecturer is a person who helps you help yourself [...] The most important lesson I learnt from the lecturer was how to be *independent* and confident in all I do. He gives *platforms* to the students, *encourages* and *listens* to the students.' (KK, student, date unknown)

In this course, the lecturer encouraged the students to take their initiative in order to achieve their goals. The students responded by taking action, rather than waiting for the lecturer to tell them *what* to do or *how* to do it.

## Need for evaluation (so what)

Fourth, educators need to fulfil one of the most important aspect in SDL, namely the need for evaluation. Thus, they need to set clear goals for the students to aim for and to communicate to them how they will evaluate such goals. In postgraduate research, the students are evaluated based on how well they complete a substantial piece of research (a thesis or dissertation); undergraduate students do not have such goals. Therefore, setting clear goals such as the publishing of a conference or journal paper or surveying more than 2000 students provided a compelling goal for this group of students:

> '[*W*]anting my name on the research paper, but being part of the research team would require extra hours and a sacrifice of my holidays. This was exciting to me because I knew I was part of something bigger than just an exam assignment.' (YH, 08 June 2012).

As one of the students reflected, their reasons for participating in the research project were to 'gain exposure in the academic community from journal articles and conferences' and 'the need to accomplish something recognisable and be credited for it' (TG). This form of evaluation also addresses the students' basic needs (Maslow 1954) for self-evaluation and to gain recognition for their work. As MG reflected:

> 'I can say that it contributed to my need for *self-actualisation*. Our team building activities has added to my need for self-esteem and belonging.' (MG, student, 08 June 2011).

Even though the goals for the course may have been predetermined, in an SDL environment, the students need to participate in the development of their own course objectives. This can be achieved in terms of formalising learning contracts (Hiemstra 1994) that allow the students to assess their own progress and to move on to the next stage once they have achieved mastery of the previous stage.

## Discussion

The students in this cohort experienced this staged teaching approach as a journey of discovery. It is not a coincidence that they used terms typically ascribed to a journey as a metaphor. Terms such as 'course' and 'curriculum' itself are broadly used in educational lexicology (Lotz 1996:12). The journey that the students experienced stands in stark contrast to the typical course where they are merely spectators. In this journey they participated as 'explorers' and not as 'tourists'. Explorers have to find out for themselves *how* and with what means to get to their destination. Tourists, on the other hand, purchase a package tour, and are dependent on the tour guide to show them the points of interests and to get them to their destination. Not everyone wants to (or needs to) be an explorer, and some are able to pay for their experience as a passenger. Educating students as tourists, however, limits their abilities to learn and contribute to the discipline, as they are reduced to mere knowledge consumers.

One also needs to differentiate between knowledge consumption and knowledge creation. The *raison-d'etre* of research is to make a meaningful contribution to the field discipline, whereas knowledge consumption essentially comprises relating new concepts to previous knowledge. Both of these aspects are important in a discipline; however, knowledge consumption does not necessarily advance disciplinary knowledge.

## Who is teaching?

The most significant gap in our theoretical model is the construct of 'Who', that is, who is doing the teaching and who is doing the learning. Contemporary curriculum privileges the curriculum developer, the content producer (what is learned) and the outcomes (why it is learned) at the expense of marginalising the educator (who), the learner (who) and the process of learning (how). This reduces educators to mere implementers or conveyancers of the content of the curriculum and education to the transmission of subject knowledge. In an SDL curriculum, the role of the educator and the learner characteristics become more important than the content. We can explain this situation by considering the degrees of perceived freedom, both of the educator and the learner. We believe that the locus of control, or *who* directs the learning has to do with perceived individual freedom to teach or learn (Harland 2017; Rogers 1969). The development of self-directed learners is directly linked to the freedom of the educators and the learners to direct *what* is learned and *how* it is learned (Rogers 1983). These theoretical constructs of SDL have also been linked with later developments such as capability theory (Steyn et al. 2016; Van der Walt 2016; Wells 2019). Without true freedom to teach and the freedom to learn what is important both to the educator and learner at the time of learning (Bentley et al. 2006; Harland 2017), the students are 'patronized … (by) giving them a false sense of what it means to be educated' (Wilcox 1996:174).

As Brew and Mantai (2017:555) state, academics feel that they have limited freedom to introduce RBL in the classroom because of perceived higher workload, lack of knowledge of how to facilitate it or lack of required support or resources. In this way, the educational system continues with the status quo (Freire 1970; Habermas 1972), and assessing students on their success as to how well they are able to conform to prescribed academic standards of excellence (Harland 2017). This indoctrination occurs at the expense of liberal and critical education where students learn to evaluate their own knowledge and have the freedom to determine their own 'course' or direction. Until this role of the educator and the student is recognised in the contemporary curriculum, we will continue to be led by the primacy of the curriculum. It is the responsibility of adult educators to critically question their roles as educators and the constraints of the curriculum and to develop a critical pedagogy (Freire 1973) that is directed at giving students the freedom to determine their own curriculum. This is particularly important for a society such as South Africa that has recently emerged from the oppression of apartheid (Fiske & Ladd 2004), so as not to persist in a pedagogy of indoctrination.

## Who is learning?

More importantly, we found that the emphasis in an SDL curriculum needs to return to the development of the students' personal (self) identity as well as their professional identities. This disjunction is presented by Maton (2014) as the epistemological gap between knowledge and the knower. Wilcox (1996) observes that:

> [*T*]he adult education model of SDL concerns itself with the process of learning *and* the *identity* of the learner, and proposes that the desired result from a SDL episode is growth, change and development-earning that is personally meaningful, and therefore particularly useful. (p. 175)

Students need to learn what it means to be a member of the discipline; not only in terms of what they need to know (as in a traditional curriculum), but more importantly *what* they are to do, *how* they are to behave and *who* they are to become as a person. This need is expressed by KM in one of his reflections:

> '(It was in week thirteen that) … I wrote my first real reflection on a personal note and realized the true value which this module has given me, *self-identity* and realizing how much I can learn for myself without any instructor.' (KM, student, 14 June 2013)

Self-identity alludes to the Delphic inscription of 'know thyself' which refers to the knowledge of self as the knower, and hence also recognising what one knows and does not know. This is a continuing thread in adult education where the search for self-identity materialises as a problem of existence in the modern era (Rogers 1983:33). Although this formation of self-identity is related to self-efficacy and self-regulation (Zimmerman et al. 1992), they are not the same concept. Self-regulated learners are able to direct their own learning and are able to set their own (challenging) goals (Bandura 1971). Self-efficacy, in contrast, is the belief that a person has in their own abilities to perform a particular task or to achieve a learning goal (Erel 2000). According to Ahbel-Rappe (2018), self-identity:

> [/]s this opening up of self-knowledge that results in the release of the narrowly construed desires, opinions, and habits, which drive a constant engine of wanting, acquisition, and, inevitably, dissatisfaction. (p. 7)

A research curriculum such as we outlined here provides the student with the opportunity of learning more about themselves in the context of the discipline. Encouraging the students to research things for themselves helps them to develop their own sense of what they know and where their interests lie. This develops their self-understanding of their own knowledge and limitations; that is, it provides them with a better sense of their own identities. This growing self-identity further leads to the development of their professional identities in the subject and/or discipline (Sawatsky et al. 2017:6). Students thus become empowered to 'see' themselves as practitioners in the discipline with the ability to learn more and contribute to the field.

## The role of encouragement

The role of motivation in self-regulation is well recognised (Bandura 2001; Du Toit-Brits & Van Zyl 2017). Central to our thesis of advancing students' abilities for self-direction in research is focusing on what motivates (moves) them to learn (why to learn) something new (what to learn) or to attempt a new activity (how to learn). To be meaningful, this motivation needs to be intrinsic (Hung 2014). Fundamentally, emotions drive motivations, as is reflected in their etymological roots. We understand this process as an outcome of our research as follows: if the educator motivates the student extrinsically, for example, either through reward or punishment, this motivation ceases when the rewards or punishment cease. If the student is intrinsically motivated, for example, by personal achievement or growth, this motivation is much more sustainable, and the student is prepared to take on much greater challenges in order to achieve their goals. The way that the educator needs to facilitate this process by encouragement through taking on the role of a consultant or mentor (Grow 1991):

> 'He *encouraged* us to take initiative, be *self-directed*, think freely and be innovative and creative. He strategically planned our assignments as well as (our) classes.' (MH, student, 14 June 2013)

Developing self-directed learners is frequently referred to as a process of guiding rather than teaching. Our findings indicate that providing students with too much guidance reduces their own self-directing abilities. In an SDL research curriculum, guidance needs to be reduced, and encouragement needs to be increased. In this regard, our findings contradict contemporary SDL and related literature on minimally guided instruction (Kirschner et al. 2006:8). Encouragement needs to develop students' courage to take the first step and to continue on their journey of discovery (research) in the face of adversity. Courage is one of the four cardinal virtues of wisdom, courage, temperance and justice (Morales-Sánchez & Cabello-Medina 2013). Courage is also a necessary condition for SDL to commence.

But it is perhaps in the virtue of temperance where SDL may find its closest theoretical support. Temperance refers to self-mastery, where a person's reason prevails over their pleasures and desires (emotions) (Plato Republic, 431). This aspect can easily be observed amongst first-year students that are struggling to adapt to 'student life' versus 'academic life'. Some are able to maintain a balance between the two (temperance), whereas other's either favour the pleasures of student life (and possibly drop out), or the rigour of academic life (and become a nerd). For Plato, the purpose of the state is to educate and nurture the polis. 'If our citizens are well educated, and grow into sensible men, they will easily see their way through all these (regulations which we are prescribing)' (Plato Rep. 431). Sometimes students (of virtue) may not want to do something new or different, that is, something outside their comfort zone, yet they might know on an intellectual level what the right thing is to do in the circumstance. It is here where the wisdom of the educator can assist students in differentiating between their wants and their needs, thus developing the habits that are necessary in order to achieve their goals. Once students develop their own judgement, they are able to determine for themselves what to learn and how to learn it. In this way they are able to teach themselves.

## Pedagogy versus self-directed learning

In closing, it is worthwhile to reflect on some of the differences between a pedagogical approach versus a self-directed approach in teaching research to undergraduate students. In a pedagogical approach, the lecturer sources the required information and structures a course and lectures around it. In this way, the lecturer, rather than the student, makes sense of a particular topic or research discipline and learns how to structure and present it to the students. In an SDL approach, such as we followed here, we transferred the responsibility for these activities to students so that they could benefit from the learning process themselves, much like in a 'learning through teaching' approach (Marquardson & Schuetzler 2019). In this way, both they and their fellow students, the lecturer, and even the broader discipline may ultimately benefit from their research. Of course, this approach runs the risk that students do not source, present, or find the same quality information as a lecturer would. This would be one of the disadvantages of such an approach. It does allow students to start learning through the same process that an expert uses to learn, at a much earlier stage in their career. In addition, because they researched the information for themselves, they tend to have much greater recall ability of the material than they would have if it was given to them:

> 'The assignments required us to practice research tools like literature reviews, summaries and synthesis. *No* lecture has been dedicated to *teaching us how to do this* but, we had to figure out ourselves how to do it and managed to do it so well that I have learnt that *I can do work on myself* and *educate myself* without an instructor.' (KM, student, 14 June 2013)

Most educational approaches, particularly in content-based education, vary the topic or content of learning throughout the course or semester, yet the methods of teaching and learning remain reasonably constant. In a research-driven curriculum such as this, educators can keep the topic reasonably constant throughout the semester (i.e. what is learned) but change their teaching and learning methods in modality (i.e. how it is learned). This is important because the emphasis of a research-based curriculum is in the development of research skills and techniques and not the acquisition of content or disciplinary knowledge ... although such knowledge is acquired incidentally.

In this way, the educator needs to provide their students with the tools (how to learn or do), and the tasks (what to do), but not pre-specify the outcomes or objectives (why to do); as each student will have different individual needs. In contemporary outcomes-based curriculum, the learning outcomes need to be pre-specified, which makes a RBL approach more challenging to implement. In a journey of research and discovery, one never knows beforehand what one might discover along the way or even how long it will take. This has much more in keeping with mastery learning (Bloom 1968; Washburne 1922), where the units of achievement are kept constant, and the time for achieving mastery is varied according to the needs of the learner. In this way, the course provided an opportunity for students to learn more about their own interests, strengths and weaknesses, to explore a new topic or field, disciplinary theories and methods, to learning how to do research and write in a community of peers. These are fundamental competencies in SDL curricula as it is the student that needs to be developed and not the curriculum.

## ■ Conclusion

In an era where information is expanding at a rapid rate, one of the necessary skills for the 21st century is SDL (Beetham & Sharpe 2007). This requires the students to be self-directed in their own learning needs, according to Knowles (1975). Evidence still shows that the students have become dependent on a system of education where the curriculum and educator determine what is learned. As the first author reflected at the time (Uys 2018):

> The most important aspect of developing self-directed learners [*in this course*] was through a process of assigning them [*the students'*] tasks [*and activities on which they needed to reflect*] and then encouraging them along the journey of completing these tasks. (p. 339)

We found that providing too much direction for students on *how* to do assignments restricts their innate abilities to become self-directed. Likewise, restricting lecturers' freedoms in terms of *what* they should teach, as encapsulated in terms of course objectives and outcomes, limits their self-directing opportunities in the classroom of *how* to teach. Limitations of the theoretical model are that it does not consider the personage (Who) of the lecturer and the student. This limitation can be ascribed to an educational system that has mitigated the role of the lecturer and the student (who) in deference to the content or subject that is being taught (what) and even how it is being taught. This dilemma is further exacerbated in South Africa by the appointment of educators based on their disciplinary expertise and not their pedagogical knowledge.

Assessment also becomes important in an RBL environment as the students are not given written tests but are evaluated based on their research and writing outputs. In this way, it may be of value to develop assessment instruments and assignments for the students to assess their own progress at each stage of the research process and possibly implement a competency-based curriculum such as learning contracts (Hiemstra 1994) where the students are promoted to the next level once they achieve mastery at the previous stage. These are possible areas for further research that may be of value to the broader SDL community. Further research also needs to examine the role of the educator in facilitating the SDL process and examine how SDL models can be adapted to incorporate this interpersonal dimension.

## ■ Acknowledgements

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# Appendix

**TABLE A2.1:** Reflection prompts provided to the students.

| Element | Reflection prompt |
|---|---|
| **Which** | *Which* subject, topic or issue that you are researching? |
| **What** | Outline *what* you learned in this module? Refer to the assignments that you were given, lectures in class, guest lectures, and activities that you participated in. |
| **When** | When you did the activities mentioned above? You don't need to give a detailed account of these activities, but try and be specific as to when you learnt significant things, whether it was inside or outside the classroom. Also refer to the timing of assignments, when you were given them, whether you had sufficient time to complete them, as well as the impact that other events such as other modules tests, exams etc. had on this module. |
| **Where** | This relates to the specific places where learning occurred. Be specific on what effect the classroom environment had, and specific places outside the classroom, e.g. on campus, the library, res etc. |
| **With** | This aspect refers to the specific tools and resources that you encountered or used during the course of the module, e.g. money, transport, computers, mobile phones, software such as Mendeley, Office, Dropbox, Computer labs, the internet etc. |
| **How** | How – What DID you do during the course of the module and specifically the research project (refer to your diary). How did you learn during the course of the module? How did the lecturer teach the module? How did you experience this teaching approach? |
| **Who** | Who – Who was involved in your learning, and what impact did they have on what you learned e.g. the lecturer, other lecturers, support functions e.g. the librarian, writing centre, fellow students in the module, other students? |
| **Why** | What were your expectations for the course. How this had changed/or not during the course. Your future goals and ambitions now. What this module meant for you personally? |

*Source*: Authors' own prompts, categorised according to Aristotle's (Sloan 2010:236) elements of circumstance.

Chapter 3

# Implementing guidelines for deeper self-directed learning in Computer Applications Technology education: Implications for lifelong learning

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## Abstract

Research indicates that SDL and lifelong learning should be fostered in education to prepare students for a changing world. A literature review was done to obtain an understanding of SDL and lifelong learning. The review indicated that SDL is essential for lifelong learning. The literature further indicated that to fulfil the requirements of the 21st century, deeper learning should be fostered among students in order for them to have the competency to transfer knowledge to new situations. It was therefore suggested that deeper SDL must be developed among students. The aims of this study were to determine how deeper SDL could be developed in a database module in Computer Applications Technology education and what the effect of implementing the guidelines was on students' inclination towards lifelong learning. Strategies to promote transfer and to develop self-directed learning, while incorporating cognitive load theory and social constructivist theory, were combined to develop guidelines for deeper self-directed learning. The effect of the implementation of the guidelines in the Computer Applications Technology class on students' inclination towards lifelong learning was then determined. The study concluded that implementing guidelines for deeper self-directed learning in a database module in Computer Applications Technology education can improve students' inclination towards lifelong learning.


**Keywords:** Self-directed learning; Deeper learning; Lifelong learning; Computer Applications Technology; Deeper self-directed learning.

## Introduction and background to the problem

Learning in the 21st century constitutes far more than memorising facts and applying procedures. Currently, education has to prepare learners for an unknown future, in a world characterised by change and complexity (Ellis, Han & Pardo 2018:10). Requests to transform education are constantly raised (Society for Human and Resource Management [SHRM] 2019:2).

According to Knowles (1975:15), ‘the skills of enquiry’ have to be developed. The National Research Council (NRC) (2012:13) of the United States stated that the acquisition of 21st-century skills has become an inextricable part of learning. Skills such as ‘applied skills’, ‘cross-curricular skills’, ‘interdisciplinary skills’ and ‘transferable skills’ are indicated as ‘critically important’ skills (Hewlett Foundation 2017:16). New knowledge has to be created, old information has to be updated and people need to be retrained (Merriam, Caffarella & Baumgarterener 2007:2). A guiding principle for education, thus, is that developing lifelong learning should be the keystone of learning (Faure et al. 2013:181). However, according to Conley (2014:13), education has not yet realised the need to develop a ‘high-skills knowledge economy’, where people are required to learn continuously and develop the skills to face the demands of a changing job market.

Despite continuous calls for education to develop 21st-century competencies, Boss (2019) argues that the development of 21st-century competencies is still a concerning issue. According to the SHRM of the United States, a global shortage of skills exists and the situation is deteriorating (SHRM 2019:3). Apart from technical skills that are lacking, the SHRM (2019:3) report that the top missing skills are problem-solving, critical thinking, creativity, innovation, the ability to deal with complexity and ambiguity, and communication.

Several suggestions have, in reply, been proposed to acquire necessary 21st-century competencies. Conley (2014:13) states that students have to be prepared as lifelong learners. Self-directed learning is named as a ‘key factor’ for lifelong learning (Cheng et al. 2010:1152). Guglielmino (2013:2–3) proposes that learners’ full potential as self-directed learners needs to be developed to embrace the challenges of the 21st century. Self-directed learners will thus be ready to learn what is required to cope with change (Knowles 1975:20).

Apart from SDL, additional learning outcomes for learning in the 21st century are required (Martinez, McGrath & Foster 2016:3). Self-directed learners should embrace a 'learning culture' and develop academic mindsets (Martinez et al. 2016:11). The ability to transfer knowledge has also been identified as an essential, but 'relatively neglected' competency (Goldstone & Day 2012:149). The term deeper learning (DL), or learning for transfer (Bellanca 2015:7), emerged from a study conducted by the NRC (2012). To thus sufficiently prepare learners for the 21st century, none of SDL or DL can be ignored (Martinez et al. 2016:11). Learners should be deeper self-directed learners, who take ownership of their learning, who can transfer knowledge and who have a multitude of 21st-century competencies in the cognitive, intrapersonal and interpersonal domains (NRC 2012:3).

In South Africa, Computer Applications Technology (CAT) education students take database design as a subject in their teacher training. As future teachers, they are required to be lifelong learners and develop their learners' competencies. As CAT teachers, they are likely to have responsibilities to maintain databases in the school environment, where they have to apply their knowledge to several real-world scenarios. Computer Applications Technology teaching students subsequently need to be self-directed learners, have deep subject knowledge and should be able to transfer their knowledge to various real-life situations.

The following research questions were therefore addressed in this research:

1. Which guidelines regarding instructional practices can be determined to develop deeper self-directed learning (DSDL) in a database module in CAT education?
2. What are the implications of implementing guidelines for DSDL on students' inclination towards lifelong learning?

To answer the above research questions, a literature review first had to be done to determine guidelines on how DSDL can be developed. Thereafter, the guidelines had to be implemented and their effect on students' disposition towards lifelong learning had to be determined.

# Conceptual–theoretical framework

The social constructivist theory (SCT) and the cognitive load theory (CLT) were used as theoretical grounding for DSDL. The SCT and the CLT will therefore be discussed and DSDL will be defined. Finally, strategies to promote transfer and SDL will be discussed, with the aim of suggesting guidelines to develop DSDL. Finally, the link between DSDL and lifelong learning will be discussed.

## Social constructivist theory

Social constructivist theory describes learning as a process that occurs through social interaction (Thomas et al. 2014:2). According to Murphy et al. (2005:342), SCT as described by Vygotsky (1978) assumes 'that knowledge construction is achieved by the interaction that takes place within oneself through reflective thinking and by the interaction that occurs in communicating and collaborating with other people'.

Trilling and Fadel (2009:108) state that forms of collaborative learning practices have greater impact on student performance than any other variable. When students are collaborating, they are actively involved in learning (Herrington & Herrington 2006:2). Wirth (2007:1) accordingly argues that lecturing does not promote in-depth understanding. To develop deep learning and understanding, students should therefore be active participants (Halpern & Hakel 2003:40), who are collaborating and interacting with others (Vygotsky 1978).

## Cognitive load theory

Cognitive load theory (Sweller 1988) focuses on balancing cognitive loads that impose on memory during learning and instruction. Especially when learning complex tasks, an overwhelming number of elements need to be processed, which can impact on meaningful learning (Paas, Van Gog & Sweller 2010:116). The focus with CLT is thus on controlling the 'excessively high load imposed by complex tasks' (Paas et al. 2010:116) during instruction.

Paas et al. (2010:116) describe the process of learning as an interaction between long-term memory (LTM) and working memory (WM) in the learner's mind. Long-term memory stores knowledge in the form of schemas (Mason, Seton & Cooper 2016:69), where multiple elements of information are combined into a single construct and become one element again (Chi, Glaser & Rees 1982). These schemas can also be described as templates for solving problems (Sweller, Ayres & Kalyuga 2011:23). While the LTM is considered to have unlimited capacity, the WM is limited in duration and capacity (Sweller et al. 2011:19). New content in the WM therefore needs to be rehearsed constantly and to be connected to schemas in the LTM (Sweller et al. 2011:43).

During instruction and learning, available resources in the WM are allocated to various types of cognitive load (Sweller et al. 2011). Intrinsic cognitive load is imposed by the nature and the structure of information, and it is affected by the difficulty of the content (Sweller et al. 2011:57) and the expertise of the learner (Van Merriënboer, Kester & Paas 2006:343). Difficult content will therefore impose a high intrinsic load on the WM (Paas et al. 2010:117). Extraneous cognitive load is imposed by the way in which information is presented and by the activities that students engage in (Sweller et al. 2011). Instructional design can therefore impose unnecessary extraneous load on the WM if it has not been designed to keep the extraneous load as low as possible (Choi, Van Merriënboer & Paas 2014:227).

Although the extraneous load may be eliminated, the intrinsic load may still be too high for the WM resources in the event of difficult content. Poor instructional design with inappropriately balanced cognitive loads will interfere with schema acquisition (Paas et al. 2010:117) and thus with learning. The intrinsic load should therefore be managed by instructional design to allow balanced processing of all elements in the WM (Paas et al. 2010:118).

## Deeper self-directed learning

Deeper self-directed learning can be defined as a process, initiated by a learning need to transfer knowledge and taking ownership of learning. It is thus argued that DSDL is required to address the challenges for learning in the 21st century. Learning in the 21st century requires that students be deeper learners and self-directed learners, who take ownership of their learning, who can transfer knowledge and who have a multitude of 21st-century competencies in the cognitive, intrapersonal and interpersonal domains. As DSDL is based on the two processes, DL and SDL, they will now be discussed.

Both DL and SDL can be defined in terms of the outcomes of each process and in terms of competencies that each process requires. The NRC (2012:5) defined DL 'as the process through which an individual becomes capable of taking what was learned in one situation and applying it to new situations'. The outcome of DL can thus be described as transferable competencies. To foster DL, competencies within the cognitive, intrapersonal and interpersonal domains need to be promoted (NRC 2012:31–35). Within the cognitive domain, Costa and Kallick (2015:78) argue that habits of mind, such as to think creatively, critically and deeper, should be developed. Some competencies in the intrapersonal domain are flexibility, adaptability, intellectual curiosity, initiative, responsibility, integrity, metacognitive skills, self-monitoring, self-reflection and self-efficacy (NRC 2012:33, 139). In the interpersonal domain, competencies such as communication, collaboration, teamwork and trust-building are mentioned (NRC 2012:34).

Self-directed learning plays an integral role in developing DL (Bellanca 2015:6; Martinez et al. 2016:5). Knowles (1975:18) defined SDL as a process where learners take the initiative to accept ownership of their own learning by diagnosing their learning needs, formulating their learning goals, identifying resources, applying appropriate learning strategies and evaluating if their learning goals have been reached. Long (2000:13) defined SDL as the conscious controlling of processes involved in learning. The outcome of enhancing SDL can thus be described as increasing students' capacity to 'conduct their own learning' (Francom 2010:29).

According to Knowles (1975:21), the attitude of learners towards teaching and learning is a determining factor of SDL. Teacher-directed classrooms are usually characterised by the giving of rewards, which promotes extrinsic motivation, as opposed to SDL classrooms, where learners' intrinsic motivation is kindled, so that they can persist, develop resilience, and take responsibility for their learning (Guglielmino 2013:6). Self-directed learning thus assumes that learners 'are motivated by internal incentives', such as 'the desire to achieve', 'the urge to grow', the need to know, curiosity and the 'satisfaction of accomplishment' (Knowles 1975:21).

In the literature, a multitude of competencies are indicated for SDL and DL. A list of the competencies for SDL related to the cognitive, intrapersonal and interpersonal domains are listed in Table 3.1.

In view of the above explanations of DL and SDL, the ultimate aims of DSDL therefore are to develop learners' SDL potential to take ownership of the learning process (Knowles 1975), while promoting far transfer (the transfer of knowledge and competencies to new contexts) (NRC 2012:82).

## Lifelong learning

The aims of DSDL are incorporated within the definition of lifelong learning, as both DL and SDL are indicated as essential components of lifelong learning. Simper et al. (2016:1159) state that lifelong learning has been described as 'deliberate,

**TABLE 3.1:** Self-directed learning competencies in the cognitive, intrapersonal and interpersonal domains.

| Cognitive | Intrapersonal | Interpersonal |
|---|---|---|
| • Comfortable with uncertainty and change (Kell & Van Deursen 2002:32).<br>• Creativity (Edmondson, Boyer & Artis 2012:45; Guglielmino 2013:9).<br>• Critical thinking (Bailey & Mentz 2016; Borrás 2016:9; Boyer & Usinger 2015:23; Garrison 1992:147; Mariano & Batchelor 2018:152)<br>• Curiosity for learning (Edmondson et al. 2012:45; Guglielmino 1978:73; Knowles 1975:21).<br>• Goal-oriented (Guglielmino 1978:73)<br>• Initiative (Guglielmino 1978:73; Kell & Van Deursen 2002:32).<br>• Innovation (Guglielmino et al. 2009:10).<br>• Manages own learning (Dehnad et al. 2014:5186; Guglielmino 1978:73).<br>• Manages time (Guglielmino 1978:73; Kell & Van Deursen 2002:32).<br>• Needs to know (Knowles 1975:21).<br>• Needs to analyse (Guglielmino et al. 2009:19).<br>• Seeks knowledge (Guglielmino et al. 2009:19).<br>• Paces learning (Guglielmino 1978:73).<br>• Problem-solving (Guglielmino 2013:9).<br>• Strategic thinking ability (Zsiga 2008:306).<br>• Vision (Guglielmino et al. 2009:19). | • A desire to change (Guglielmino 1978:73).<br>• A desire to learn (Guglielmino 1978:73).<br>• A growth mindset (Dweck 2015:10; Van Deur 2018:4; Yeager & Dweck 2012:303).<br>• Ambition (Guglielmino et al. 2009:19).<br>• Attitudes towards learning (Guglielmino 2013:8; Mentz & Van Zyl 2016).<br>• Completes work (Guglielmino 1978:73).<br>• Conscientiousness, agreeableness, emotional stability and openness (Kirwan, Lounsbury & Gibson 2010:21).<br>• Emotional intelligence (Gavriel 2015:65).<br>• Enjoys learning (Guglielmino 1978:73).<br>• Evaluates own learning (Merriam et al. 2007:107).<br>• Independence (Guglielmino 1978:73).<br>• Life satisfaction (Edmondson et al. 2012:45).<br>• Metacognition (Loyens, Magda & Rikers 2008:417; Van der Walt 2014:7).<br>• Motivation (Guglielmino et al. 2009:19; Knowles 1975:21; Long 2000:17; Van Deur 2018:4).<br>• Overcomes obstacles or hardships (Guglielmino et al. 2009:19).<br>• Passion (Guglielminoet al. 2009:19).<br>• Perseverance (Bolhuis 2003:341; Kell & Van Deursen 2002:32).<br>• Persistence (Guglielmino 1978:73).<br>• Proactive in learning (Merriam et al. 2007:107; Williamson 2007:66).<br>• Problems are seen as challenges (Kell & Van Deursen 2002:32).<br>• Reflection (Patterson, Crooks & Lunyk-Child 2002:28; Van Deur 2018:3).<br>• Resilience (Guglielmino 2013:6; Yeager & Dweck 2012:303).<br>• Responsibility for own learning (Dehnad et al. 2014:5186; Guglielmino 1978:73; Merriam et al. 2007:107).<br>• Risk taking (Guglielmino et al. 2009:19).<br>• Self-confidence (Guglielmino 1978:73; Kell & Van Deursen 2002:32).<br>• Self-discipline (Guglielmino 1978:73).<br>• Self-efficacy (Cazan & Schiopca 2014:641; Zimmerman 2013:137).<br>• Self-reliance (Guglielmino et al. 2009:19). | • Altruistic (Guglielmino et al. 2009:23).<br>• Collaborative (Knowles 1975:61).<br>• Empathy towards others (Gavriel 2015:65).<br>• Explains to others (Knowles 1975:61).<br>• Helps others (Knowles 1975:61).<br>• Receives help from others (Knowles 1975:61).<br>• Shares knowledge (Guglielmino et al. 2009:24).<br>• Social responsibility (Guglielmino et al. 2009:19).<br>• Views peers as resources (Knowles 1975:61).<br>• Views others as mutually helpful (Knowles 1975:61). |

continuous, self-directed learning'. Candy (1991:425) states that lifelong learning begins and ends with SDL. Accordingly, Blaschke (2012:56) argues that strategies to develop SDL should be incorporated in educational methods to foster lifelong learning. Students should thus be assisted to 'develop tools for learning' to prepare them for becoming lifelong learners (Conley 2014:13).

## Strategies to promote transfer

To develop a capacity for transfer is considered one of the most important aims of learning (Collard, Brédart & Bourguignon 2016:242; Pai, Sears & Maeda 2015:82). Transfer is, however, still indicated as a concerning issue (Dixon & Brown 2012:1), which is difficult to achieve (Pai et al. 2015:82). When teaching is not specifically planned for transfer, Merriam and Leahy (2005:2) argue that application of what has been learnt is 'left to chance'.

Several suggestions have been made to promote transfer. Favourable situations for transfer need to exist (Herrington, Herrington & Glazer 2006:191), such as scenarios that students designed themselves (Taylor, Russ-Eft & Chan 2005:694). When training is perceived as useful and valuable, students are more likely to transfer what they have learnt (Grossman & Salas 2011:103). Opportunities to practise skills should furthermore be provided, including error management and how to anticipate and handle problem situations in realistic, positive and negative environments (Grossman & Salas 2011:107).

To solve problems in realistic environments can also be described as authentic tasks (Herrington et al. 2006:4–6), which have been shown to enhance motivation and to provide meaning and relevance to academic work (Parsons & Ward 2011:462–463). Motivation in turn has been widely identified as a factor affecting transfer (Blume et al. 2010:1065; Grossman & Salas 2011:103). Without motivation to transfer, Gegenfurtner et al. (2009:403) argue that newly acquired knowledge and skills will rarely be applied. A link with accomplishment and motivation is further noticed, as accomplishment of goals can be seen as a motivational aspect of transfer (Belenky & Nokes-Malach 2012:400).

According to the mechanism of identical rules, transfer is 'determined by the number of overlapping production rules' (the procedural knowledge of 'knowing how to perform tasks') between two tasks (Nokes-Malach & Mestre 2013:186). A second mechanism of transfer, analogy, is described as the application of three processes (Nokes-Malach & Mestre 2013:186). These three processes can be related to the three mental bridges of 'detect', 'elect' and 'connect' (Perkins & Salomon 2012:252). Analogy can thus be explained as (1) retrieving a prior example ('detect'), (2) creating an alignment and mapping between the prior example and representation of the new problem ('elect') and (3) drawing an inference appropriate to the new problem ('connect').

Research suggests that for novices, 'analogy is triggered by tasks that are similar on the surface' (Nokes 2009:3). Therefore, analogy is often used by novices in near-transfer situations (Nokes-Malach & Mestre 2013:186). Novices should therefore specifically be guided to recognise similarities and possible transfer situations and to make abstract representations in order to recognise deep-structure similarities in far-transfer situations (Nokes-Malach & Mestre 2013:187).

Repeated experience with the same information, but in different contexts, will help identify the similarities between problems (Collard et al. 2016:249). When students compare unsolved problems, analogical retrieval between the two problems will be facilitated, allowing them to obtain a more abstract understanding of the problem (Kurtz & Loewenstein 2007:338). Students therefore do not need to learn everything correctly the first time when aiming to ultimately achieve successful analogical retrieval and transfer (Kurtz & Loewenstein 2007:338). Transfer, however, is not only influenced by the similarities between situations but also influenced by the inclination of a student towards transfer and making connections (Goldstone & Day 2012:150).

A third mechanism of transfer, knowledge compilation, interprets prior declarative knowledge and processes into procedures that can be used to solve new problems (Nokes-Malach & Mestre 2013:187). Transfer thus involves knowing how to use knowledge, as well as when to use knowledge (NRC 2000:235). In the fourth mechanism, constraint violation, a student uses prior knowledge of domain constraints to generate a new solution, evaluates the solution by taking knowledge of constraints into account and then revises the solution (Nokes 2009:3). Concerns have, however, been raised that knowledge compilation and constraint violation can cause performance errors, because of the limitations of the WM (Nokes-Malach & Mestre 2013:187). These concerns will be clarified below, in the discussion of promoting transfer in view of the cognitive load.

## Incorporating cognitive load theory to promote transfer

Perkins and Salomon (2012:257) stated that a change of mindset about knowing and learning is required in order to teach for transfer in view of the CLT. Van Merriënboer et al. (2006:346) describe the transfer paradox, in which instructional methods that have improved performance on retention tests and acquisition of knowledge, such as practising one version of a task repeatedly, step-by-step guidance and frequent and complete feedback, will not have a positive effect on problem-solving and knowledge transfer. Deep learning for transfer depends on the interaction between the intrinsic cognitive load and available learning resources in the WM (Kalyuga 2009:336). Factors such as learner characteristics, learning task characteristics and the physical environment have been identified as some main factors contributing to cognitive load (Choi et al. 2014:225; Van Merriënboer et al. 2006:349–350). Instructional design should therefore be intentionally designed in such a way that the resources available for learning are not constrained by the intrinsic cognitive load.

In the initial stages of executing complex tasks, the intrinsic cognitive load can be too high. Less processing capacity to develop internal metacognitive processes and cognitive schemas that are considered the basis for transferable knowledge are subsequently available (Van Merriënboer et al. 2006:345). The extraneous and the intrinsic cognitive loads of learning complex tasks should therefore be reduced initially to provide for more resources that can be devoted to learning (Van Merriënboer et al. 2006:345).

Suggestions to promote transfer in view of the CLT often apply the concept of 'scaffolding'. Novices still need to develop cognitive schemas, and support is therefore needed to reduce the cognitive load (Könings, Van Zundert & Van Merriënboer 2019:86). 'Scaffolding' of domain-specific skills reduces cognitive load and thus improves performance in learning (Könings et al. 2019:92). Novices should thus initially be provided with 'extensive guidance' (Kirschner, Sweller & Clark 2006:80) to prevent misconceptions or incomplete knowledge, which can be relaxed once expert knowledge has been acquired (Kirschner et al. 2006:80).

Some strategies to provide scaffolding and to promote transfer in view of the CLT will be discussed subsequently.

### ☐ *Issue worked-out examples to novice students*

Worked-out examples are one way to provide 'scaffolding' (Könings et al. 2019:86). Worked-out examples present novice learners with 'a given state, a goal state, and a full solution to be studied or evaluated' (Van Merriënboer & Kirschner 2018:71). Worked-out examples should be followed up by completion tasks, where learners are provided with partial solutions that progress until full solutions are required (Van Merriënboer & Kirschner 2018:74). Benefits of studying worked-out examples are deeper task understanding, meaningful problem-solving, lower instruction time and higher efficiency (Kalyuga 2009:333).

### ☐ *Applying the four-component instructional design model*

Frequent feedback can lead to cognitive overload, and Van Merriënboer et al. (2006:345) therefore suggest that limited feedback and guidance should be given. They developed a four-component instructional design model (4C/ID) for learning environments for complex tasks that aim for transfer of learning. The 4C/ID model suggests that a whole-part approach should be followed. 'Whole and meaningful tasks' should initially be given, in order for learners to develop a holistic view of the task (Van Merriënboer et al. 2006:349). Each subsequent task should then be more complex and should require more knowledge than the preceding simpler task. 'Scaffolding' will thus take place within the element interactivity of the tasks, as earlier tasks will have lower element interactivity than subsequent tasks.

### ☐ *Restructure course content to a 'holistic design approach'*

Research by Mason et al. (2016:83) has shown that restructuring course content in view of the CLT leads to better understanding of concepts and thus transfer to other courses. Their research was done on an introductory database course. They significantly reduced the extraneous cognitive load by sequencing topics to better assist schema construction, providing suitable worked-out examples, distributing core concepts throughout the various topics and placing greater focus on the underlying purpose of concepts in both theory and practice (Mason et al. 2016:84). This approach relates to the 'holistic design approach' with the view that 'the whole is considered more than the sum of its parts' (Van Merriënboer & Kirschner 2018:5). The focus should thus be on the interrelatedness of elements and not on reducing content to simple facts and skills (Van Merriënboer & Kirschner 2018:5).

### ☐ *Apply collaborative learning strategies*

Kirschner et al. (2018:226) define a collaborative learning task as 'a concrete, authentic whole-task learning experience that has to be completed within a given period of time in collaboration with other learners'. Kirschner et al. (2018:220) argue that a collective WM has a larger capacity than individual working memories. Collaborative learning can thus provide more processing capacity to the WM (Kirschner, Paas & Kirschner 2009:311) and may therefore be an effective means to increase transfer (Kalyuga 2009:334).

Certain conditions are, however, proposed for collaboration to be conducive to knowledge transfer. Collaborative settings require transactive activities, which can be described as activities that concern the proper functioning of the group (Kirschner et al. 2018:223). Examples of transactive activities are deciding which tasks have to be allocated in order for group members to communicate, resolve conflict and achieve consensus (Kirschner et al. 2018:225). Group members should be dependent on each other and often have to learn 'how to collaborate' (Kirschner et al. 2018:221) as they have to deal with managing the group process as well as the demands of the task (Gillies 2014:130).

Factors such as the size of the group, differences in prior knowledge of group members and previous collaborating experiences of group members can furthermore all add to the extraneous cognitive load (Kirschner et al. 2018:225). Conditions regarding task complexity, learner characteristics, group characteristics, levels of prior knowledge, familiarity with other group members and previous experiences in working in group settings have to be taken into account to take advantage of shared cognitive processing (Janssen et al. 2010:145; Kirschner et al. 2018:228). Collaborative learning tasks should thus be demanding and complex enough for all group members to necessitate working together (Janssen et al. 2010:145; Kirschner, Paas & Kirschner 2011:615).

### ☐ *Issue collaboration scripts for inexperienced groups*

Fischer et al. (2013:64) suggest that groups should be provided guidance by using collaboration scripts. Collaboration scripts will guide inexperienced groups on how to organise information and distribute activities among group members (Kirschner et al. 2018:221). Fewer transactive activities will thus be required, and the extraneous cognitive load will be reduced (Kirschner et al.

2018:228). Care should, however, be taken not to allow collaboration scripts to distract learners' attention and thereby limit deep processing of content (Kirschner et al. 2018:222).

In the above discussion, the CLT has been discussed, as well as the implications of the CLT on instructional design. The advantages of using collaborative learning based on SCT and in view of the CLT, especially with regard to complex tasks, have also been discussed, as well as instructional design issues that should be taken into account when designing instruction according to the CLT. In view of the above, it can be concluded that a synergy must be found between task complexity, group composition and the characteristics of individual group members to balance the cognitive load (Kirschner et al. 2018:229) and to provide optimal conditions for transfer.

## Strategies to foster self-directed learning

Self-directed learning can be viewed from two perspectives – in view of the outcomes of SDL and in view of learner attributes or competencies (Candy 1991:6; Merriam et al. 2007:106). This discussion will therefore focus on teachers as procedural guides that guide students to fulfil the outcomes of SDL, on developing specific competencies required for SDL and to enhance SDL within a social learning context.

### Teachers as procedural guides that guide students to fulfil the outcomes of self-directed learning

Learners' expectations regarding teaching can be a barrier to implementation of SDL. Research indicates that students initially fear the notion of SDL and prefer formal instruction at first (Williamson 2007:67). In order for learners to agree to and be willing to take on the challenge of SDL, Knowles (1975:45) recommends that learners must be informed about SDL and its purpose, as well as what is expected of them to create the right climate for SDL. Not only should learners' view of teaching change, but teachers should view themselves as facilitators and not as mere transmitters of knowledge (Knowles 1975:32). This requires of educators to be willing to abdicate their role of authority figures, with all knowledge intact, and thus expose themselves as authentic human beings, with strengths and weaknesses (Knowles 1975:33).

Gureckis and Markant (2012:464) argue that to enhance SDL, learners should be allowed more control of the content that needs to be studied. Learners should accordingly be allowed to make decisions to satisfy their individual learning needs and should be able to choose content and information that they want to access based on what they want to experience (Gureckis & Markant 2012:465). It is further suggested that by making relatively small changes to learning tasks, described as 'self-directed alternatives', 'dramatic consequences for what is learned and retained' can be achieved (Gureckis & Markant 2012:465).

As a facilitator of learning, a teacher that plans to develop SDL is described by Knowles (1975:34) as a 'procedural guide' that is 'actively involved' (Timmins 2008:303) in developing learners' SDL. The focus should therefore be on how learners should be guided in their journey of pursuing the SDL process in order to acquire knowledge, rather than being concerned with the content that has to be transmitted (Knowles 1975:38). Care should, however, be taken not to merely reduce the amount of support and guidance to students. Accordingly, Francom (2010:30) suggests that the level of SDL required in learning activities should initially match students' readiness and that a progression towards student-directed learning should be made over a period of time. Self-directed learning should thus not be regarded as an activity where learners work independently, but throughout the SDL process intensive input is required from the facilitator as the process guide (Timmins 2008:305). The facilitator provides structure to the process of SDL and focuses on building trust between the facilitator and the learners, so that the learners can accept the 'process structure' of learning, rather than the 'content structure' they are used to (Knowles 1975:37).

## Developing learners' self-directed learning competencies

Students must be provided with opportunities to practise SDL competencies (Guglielmino 2013:5–6; Knowles 1975:39). Teaching–learning strategies should be presented in such a way that students will take ownership of such strategies and that they will increasingly take responsibility for learning (Knowles 1975:35). Acquisition of SDL skills should thus be incorporated with acquisition of subject matter knowledge, and it should be done within the context of learning tasks (Francom 2010:33).

Educators are urged to create conditions or environments to maintain learners' intrinsic motivation, as several factors can undermine intrinsic motivation (Ryan & Deci 2000b:70). Educators should focus on learners' interests (Long 2000:17). Learners will hardly be motivated by unchallenging activities that do not interest them, that have no novel or aesthetic value and that are posed in uncaring environments (Ryan & Deci 2000b:71). Deci and Ryan (2008:14) further recommend that learners' intrinsic motivation should be stimulated without making use of extrinsic motivation strategies (Deci & Ryan 2008:14). Van Deur (2018:4) argues that when learners have appropriate mindsets and believe they can be self-directed learners, it will positively influence their motivation, and thus the development of their SDL skills.

Positive feedback can trigger intrinsic motivation, while negative feedback will have a negative effect on intrinsic motivation (Deci & Ryan 2008:15). Feedback should also be informative rather than controlling, as controlling feedback, although positive as well, can have a negative effect on intrinsic motivation (Ryan 1982:459). Feedback should thus be carefully planned and should be honest, but still positive and not controlling, in order to enhance intrinsic motivation and SDL.

In view of the above, mindsets can be seen as a driving force for fostering SDL skills (Van Deur 2018:4). Bellanca and Guglielmino (2014:1) believe that students should be assisted to develop SDL 'habits of mind', so that they can take a permanent and lifelong SDL approach to decision-making and learning.

The above discussion focused on creating a climate for SDL in the classroom. It was indicated that a change from teacher-directed classrooms to SDL classrooms should be made by both teachers and learners. Positive attitudes towards learning and intrinsic motivation were described as important factors determining SDL. It was further suggested that teachers and learners should strive for growth mindsets to view teaching and learning through an SDL perspective and that learners should be allowed more control of the information they experience.

## □ Create conditions for learning within a social context to develop self-directed learning

Teacher-directed approaches are not sufficient to foster SDL (Hiemstra 2013:31). One aspect that cannot be ignored when selecting teaching–learning strategies to foster SDL, therefore, is learning within a social context. Accordingly, Bolhuis (2003:329) suggests that fostering SDL should include learning as a 'social phenomenon'. Candy (1991:22) challenges educators to assist learners to accomplish their goals and achieve their potential 'within a social context'. Although learners may view themselves as self-directed individuals that can work on their own (Candy 1991:42), it is argued that 'even truly independent and solitary learning activities' often are the 'result of the learner's membership in some group' (Candy 1991:22).

## □ Knowledge surveys as a strategy to foster self-directed learning

Knowledge surveys were originally proposed by Nuhfer and Knipp (2003) as a self-assessment tool to assess gains in teaching and learning. Wirth and Perkins (2005:1–2) describe knowledge surveys as consisting of a large number of questions that cover the full content of the course – addressing different levels of the cognitive domain. When answering knowledge surveys, students indicate their perceived ability to answer certain questions on a three-part scale, with response options ranging from 'I do not understand the question' to 'I am confident that I can answer the question' (Wirth & Perkins 2005:2).

Knowledge surveys serve as learning guides that focus on course objectives and learning goals (Wirth & Perkins 2005:3). Instead of focusing on content and facts, knowledge surveys 'clarify higher-order learning objectives' (Wirth & Perkins 2005:3) and assist students to identify 'gaps in their understanding' (Wirth & Perkins 2005:4).

Knowledge surveys have been confirmed to improve aspects related to SDL. Examples are determining learning needs (Wirth & Perkins 2005:3), metacognition (Clauss & Geedey 2010:22), and attitudes and behaviour towards learning (Decker et al. 2014:145). Therefore, from an SDL perspective, knowledge surveys can help students to diagnose their learning needs, by evaluating learning outcomes. Students may thus reflect on their learning and be encouraged to find appropriate resources and implement appropriate learning strategies to satisfy the identified learning needs.

In this section, the educator's role in fostering SDL as a 'procedural guide' (Knowles 1975:34) was discussed. Suggestions for fostering SDL in the classroom, such as learning in a social context, were made. Lastly, knowledge surveys were discussed as a possible tool to assist students identify their learning needs and develop their metacognition and thus foster SDL.

## ■ Method of research

This research was done from a pragmatic paradigm, and design research was applied as the research methodology.

## Pragmatic paradigm

A pragmatic research paradigm was used to provide optimal, practical solutions (Shannon-Baker 2016:322) for developing DSDL in a database module in CAT education.

To develop guidelines for DSDL was a complex issue, as interventions had to be done 'in a lifelike way' (Middleton et al. 2008:29) that entailed that a variety of variables could influence the outcome of interventions. Various in-depth procedures were subsequently required to collect and analyse data to obtain the effect of interventions (Middleton et al. 2008:29).

## Design research

With design research, the gap between research and practice in education can be bridged (Anderson & Shattuck 2012:16), and theoretical and practical issues central to the study of learning can be addressed (McKenney & Reeves 2012:63).

In this research, DSDL first had to be defined, to make a theoretical contribution to the body of literature. The learning phenomenon of DSDL was then studied in a real-life application, namely in the CAT class at a university. Interventions to foster DSDL had to be developed, analysed and refined to provide practical solutions to the education community. Each time, design responses were informed by the knowledge gained, as suggested by Lobato (2003:18).

The research design consisted of multiple phases and was done over a period of four years. Figure 3.1 depicts the time frame of the research. In the remainder of this discussion, the four years of the research will be named as phases 1 to 4. In the first year of the study (phase 1), the research problem was identified and established, as indicated by Middleton et al. (2008:28). The research had to be tentatively planned and proposed to the required committees and authorities. Deeper self-directed learning was defined, and a theoretical model for DSDL was developed by reviewing the literature.

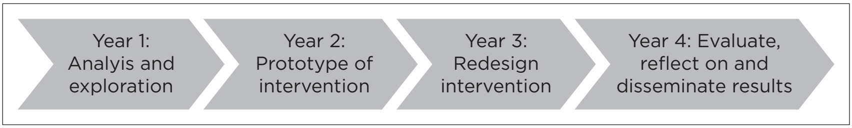



**FIGURE 3.1:** Time frame of design research to develop guidelines for deeper self-directed learning.

In the second year of the study (phase 2), a prototype of the intervention (Middleton et al. 2008:32–41) was designed. Guidelines had to be suggested to implement DSDL in the CAT class at a university. It then had to be determined how the guidelines could be implemented and an intervention was developed. The intervention was then implemented and evaluated in phase 2. According to the results of the evaluation, the intervention was refined and implemented again in the third year of the study (phase 3) to a second group of participants. In the fourth year of the study (phase 4), the results obtained by all interventions were integrated, and guidelines to develop DSDL were proposed.

In-depth data collection using a variety of quantitative and qualitative methods was done to compensate for the lack of experimental conditions (Middleton et al. 2008:29). Although no control group was used, as suggested by Middleton et al. (2008:28), the refined intervention was again applied to a second group of participants in phase 3. The new group of participants meant that new conditions existed. However, these participants were again interviewed to determine their perceptions of the implemented guidelines. Applying the intervention to a new group of participants would also give some indication what the possible transferability of the intervention was. A rich field of data could thus be obtained to best answer the research questions (Hesse-Biber 2010:3).

Figure 3.2 indicates the various phases of data collection and when interventions were applied during phase 2 and phase 3 of the research. Two interventions were applied in each phase, after

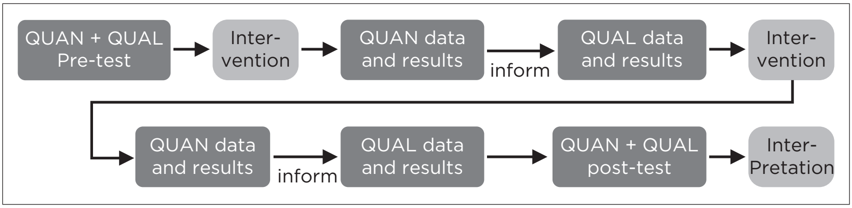



**FIGURE 3.2:** Phases of data collection.

**TABLE 3.2:** Phases of the embedded mixed methods design.

| Phase | Request | Data Collection Method |
|---|---|---|
| QUAN + QUAL | Apply intervention | Transferable Learning Orientations tool (pre-test) |
| QUAN → QUAL | Refine guidelines<br>Apply refined intervention | Transfer test to determine participants for interviews |
| QUAN → QUAL | - | Transfer test to determine participants for interviews |
| QUAN + QUAL | Integrate results to evaluate guidelines<br>Refine guidelines and intervention | Transferable Learning Orientations tool (post-test) |

which the guidelines were evaluated and refined. The second intervention was guided by the results from the first intervention. Figure 3.2 further depicts the sequence of data collection and when results of qualitative data were informed by results of quantitative data.

An embedded mixed methods design (Creswell 2014) was used within the design research. Combined convergent and explanatory sequential mixed methods approaches were incorporated within the embedded mixed methods design, as indicated in Table 3.2.

## Population and sampling

The population of participants ($N$ = 73) was two consecutive years of third-year CAT education students at a South African university enrolled for a database and networking module. Thirty-two students were enrolled for the module in the first year, and 41 students were enrolled for the module in the following year.

Considering the small size of the population, a sample from the population would not have been sufficient to reflect the characteristics of the population closely (Mertler 2016:263). Therefore, nonprobability sampling and a convenience sampling approach (Creswell 2015:145) was used. The sample consisted of all students who were willing to become involved in the research and who gave informed consent. These students will, in the remainder of this chapter, be referred to as participants. Questionnaires were issued to all willing participants, and all willing participants were invited to interviews.

## Quantitative data collection and analysis

The purpose of quantitative data-collection methods was to use reliable instruments to measure participants' inclination to transfer and lifelong learning. Transfer tests and the TLO tool (Simper et al. 2016) were used.

### Transfer tests

A transfer test was administered after each intervention (see Table 3.1). The transfer test can be described as a questionnaire consisting of open-ended questions where participants had to answer questions to determine knowledge transfer (Johnson & Turner 2003:303). A mark was allocated to each answer, to quantitatively determine the transfer attempt (Lobato 2003:18). The results of the transfer tests were then used to identify participants to be invited for interviews.

### The Transferable Learning Orientations tool

The TLO tool was developed to determine students' inclination towards lifelong learning (Simper et al. 2016:1159, 1173). Simper et al. (2016:1162) identified transfer as a dimension of lifelong learning, along with motivation, learning belief, self-efficacy and organisation. The TLO measures each of these dimensions, which will be referred to as categories in the rest of this discussion. The TLO is a triangulated measure, consisting of four scale items for each of the categories mentioned above, one rubric-type question and one open-ended question per category (Simper et al. 2016:1165). Feedback is based on a five-point scale, with responses ranging from 'Not at all like me' to 'Very true of me' (Simper et al. 2016:1162).

The aims of the open-ended questions in the TLO are to increase the validity and reliability, to provide more in-depth feedback about why a student reports at a particular level and to increase students' 'meta-cognitive engagement with the instrument' (Simper et al. 2016:1165). The open-ended questions were analysed as qualitative data.

Each participant's individual results can be plotted on a spider diagram (Simper et al. 2016:1169), to provide a visual representation of the average scores for each category. One aim of the spider diagrams initially was to provide a basis for lecturers to address the needs of their students (Simper et al. 2016:1161). Simper et al. (2016:1172) suggest that the TLO can also be administered before and after a specific pedagogical intervention, to determine its impact – for instance, the suggested guidelines to develop DSDL.

Table 3.3 shows the categories measured by the TLO, as well as the descriptions used for the various categories in the spider diagrams. Table 3.3 further indicates which questions on the questionnaire relate to which category. Questions that are reverse-coded are indicated with (r).

The TLO was administered to participants as a pre-test and a post-test (see Table 3.2). Quantitative results of the TLO were analysed by statistical consultation services, using the software Statistical Package for the Social Sciences (SPSS) and Microsoft Excel, by applying descriptive and inferential statistics. Descriptive statistics used in this research are frequency distributions, mean values and standard deviations. Inferential statistics calculated in

**TABLE 3.3:** Categories measured by the Transferable Learning Orientations tool.

| Category | Description on spider diagram | Expanded description of each category* | Questions | Open-ended question |
|---|---|---|---|---|
| Outcome motivation | Self-motivated | Intrinsic motivation | Q1, Q2(r), Q3(r), Q5 | Q4 |
| Learning belief | Flexible learner | Level of control that participants believe they have of their own learning | Q6, Q7, Q8(r), Q9(r), Q11 | Q10 |
| Self-efficacy | Confident | Confidence in learning and performance | Q12(r), Q13, Q14, Q15, Q17 | Q16 |
| Transfer | Makes connections | Inclination of participant to transfer knowledge | Q18, Q19, Q20, Q22 | Q21 |
| Organisation | Learns independently | Inclination of participant to learn independently | Q23, Q24, Q25(r), Q26, Q28 | Q27 |

*, (Simper et al. 2016:1166)
r, questions that are reverse-coded.

this research were -tests, correlation coefficients, probability values or p-values, and effect sizes. T-tests were used to indicate the difference between the means of the pre-test and the post-test.

## Qualitative data collection and analysis

Semi-structured one-on-one interviews and focus group interviews were mainly used as qualitative data-collection methods. The open-ended questions of the TLO also formed part of the qualitative data.

All the interviews were conducted in face-to-face mode, so as to obtain rich responses (Patten & Newhart 2017:187). The same interview protocols were used for both intervention cycles (see Figure 3.2), but different interview protocols were developed for the one-on-one interviews and the focus group interviews. Participants were allocated to specific groups based on the quantitative results of the transfer tests to determine a basis on which to invite participants to interviews. Participants who obtained between 75% and 100% were classified as applying successful transfer, participants who obtained less than 50% were classified as not applying transfer, and the remainder of the participants were classified as attempting transfer. It was not disclosed to participants which group they had been assigned to.

To obtain multiple perspectives and to aim for data saturation, all participants from the attempted transfer and the no transfer groups were invited to one-on-one interviews. As an element of embarrassment might exist for participants who did not perform well in the transfer tests, they were invited to one-on-one interviews to privately discuss their experiences of the interventions. Interviews lasted approximately 30 min.

All participants from the successful transfer group were invited to a focus group interview. The number of participants that qualified each time ranged between five and ten participants. It was assumed that because all the participants in this group had performed well in their transfer tests, they would be open to share their good practices, experiences and strategies in a group (Patten & Newhart 2017:164).

Recorded interviews were transcribed and checked. Transcriptions of interviews and answers to open-ended questions in the TLO were analysed by importing them into ATLAS.ti™ software. Quotes from transcriptions were assigned to codes (Krueger & Casey 2009:123) by labelling the quotes (Creswell 2015:242) on an emerging basis. Coding was also directed by the categories of the TLO.

Qualitative data were also analysed by obtaining counts of themes to indicate the relative importance of emerging themes (Bazeley 2010:444). Counts were, for example, done to determine how many quotes could be linked to self-efficacy, transfer and motivation.

## Integrating results to provide answers to research questions

The analysis and integration of all the results from the transfer tests and the interviews after the first intervention, informed the refinement of guidelines for the second intervention (see Table 3.2).

After the second intervention was applied, a transfer test was written again. The results of the transfer test again determined the interviews that participants were invited to.

Statistical analysis of the results of the pre-tests and the post-tests was done. The results of the pre- and post-TLO were plotted on the spider diagrams. A visual interpretation was made of each participant's progress on the various categories of the TLO. Quantitative results were integrated with the results of qualitative data. According to the results the following intervention could be adjusted accordingly. Finally, conclusions were made and the research could be reported on.

## Reliability and validity

Willis, Jost and Nilakanta (2007:218) suggest that when defining reliability and validity, it should be done in relation to qualitative and quantitative data, as these perspectives will differ because of the differences in the underlying paradigms. It will therefore be indicated how reliability and validity in this research were addressed, by discussing reliability separately with regard to quantitative and qualitative data.

### Reliability with regard to quantitative data

Reliability of the TLO was confirmed by Simper et al. (2016:1165), but information on reliability in the South African context could not be found at that stage, and it had to be statistically confirmed. Reliability was, however, improved in this study, by re-administering the questionnaires to different year groups of participants in two subsequent years.

### Reliability with regard to qualitative data

According to Creswell (2015:158), reliability is concerned with the trustworthiness of observations in qualitative data-collection methods. In this research, no selection bias occurred in selecting the sample, as all participants who gave consent had questionnaires administered to them and were invited to interviews. Negative cases were also included, by inviting participants who could not apply transfer to interviews. The use of ATLAS.ti™ as qualitative data analysis software further contributed to the reliability of the coding (Bazeley 2010:462). Audit trails of the coding process were available, and the coding process could be verified and tracked by other researchers. Furthermore, the same coding technique was applied throughout, and the researchers strived to be consistent and to apply sound ethical principles.

### Improving validity

The validity of the TLO has already been confirmed by Simper et al. (2016). In this research, the application of design research (Middleton et al. 2008:27), with its various cycles of design, testing, and theory building, further ensures that rigour is built into research. Triangulation (Hammersley 2008:23) was also applied by collecting and analysing qualitative and quantitative data separately and comparing results to validate interpretations.

## Ethical issues

The population consisted of students in a module facilitated by one of the researchers. The researcher therefore had to uphold a professional relationship with the students and not mention the research project or the aims of the research when facilitating the module. All possible steps (Creswell 2015:55) had been followed to be aware of possible power relations and not to disclose the identities of participants.

Ethical clearance was obtained from the relevant institutional ethics committee. Because this research involved students from the university, permission to conduct the research also had to be obtained from the university's registrar for each year that data were collected. Such permission was granted, but with the prerequisite that the researcher was not allowed to collect any data, such as marks or contact details of participants, from any of the university's administrative systems.

The participants were students in the module that took part in the research voluntarily. The researchers were not present during the recruitment process. An independent person was recruited to explain the research to the population and to recruit participants. The same independent person handed out and collected consent forms.

Careful measures were taken not to disclose which students in class had agreed to participate in the research and to treat all students in the population (whether participants or not) with the same respect and empathy. Participants had the right to withdraw from the research at any time without incurring any consequences, as indicated on the consent forms. However, as this was a compulsory module, students would still be obliged to attend the classes and to complete regular assessments for the module.

Data were collected at different stages of the research, and participants' data had to be matched. Participants' identities therefore had to be recorded when they submitted questionnaires and transfer tests. Participants furthermore had to be invited to interviews. Therefore, participants were requested to voluntarily provide their email address on the consent forms, in order to be contacted if required.

Interviews were scheduled by an independent person, via email. Participants could schedule interview times that suited them best, or they could ignore the email if they opted not to take part in the interviews. This procedure mitigated the possibility that participants would agree to take part in interviews because of a power relation between lecturer and student.

Audio recordings were done with the permission of the participants, by using two electronic devices, to ensure a backup recording in the event of hardware failure. After the recordings were uploaded for storage, they were deleted from the two devices. At all times, anonymity, confidentiality, and safekeeping of data and results enjoyed the highest priority.

In the following section the results of the research will be reported on, followed by a discussion of the results and final conclusions.

## Results of the study

The discussion of the results will focus on the development of the guidelines and the application of the modified intervention (see Figure 3.1) in phase 3, to determine the implications of implementing guidelines for DSDL in a database module in CAT education, on students' disposition towards lifelong learning.

### Guidelines to develop deeper self-directed learning

The first intervention was developed according to the literature review of guidelines to develop transfer and SDL based on CLT and SCT as a theoretical framework. As suggested by McKenney and Reeves (2012:109), the aim was to develop a 'well-considered' intervention, 'grounded in both theory and reality'. Broad guidelines with deep theoretical roots that could be practically applied in reality were subsequently suggested. Each refinement of the previous intervention was guided by the results of data collection and by literature. The interventions thus evolved according to the participants' experiences of the guidelines and guidelines found in literature.

In Tables 3.4 and 3.5, the interventions for phase 2 and phase 3 of the research (see Figure 3.1) are summarised. As indicated in Table 3.2, two interventions were applied in each of phases 2 and 3.

For the first intervention, a collaborative teaching–learning strategy was applied. Students were randomly, and thus heterogeneously, assigned to groups by the facilitator. Groups had to discuss worked-out examples based on real-life scenarios. Complex tasks had to be completed by groups in class, followed by individual tasks, which students had to complete in their own time. Examples of solutions to problems were issued to students, but not all solutions were correct. In their groups, students then had to determine if they agreed with the solutions, thus encouraging constructive controversy.

**TABLE 3.4:** Interventions and guidelines applied in phase 2.

| Intervention | Description of guidelines applied |
|---|---|
| First intervention | Apply a collaborative teaching strategy.<br>Students are randomly assigned to groups by the facilitator to form heterogeneous formal or informal groups.<br>Encourage students to ask essential questions, and cultivate the habit of asking good questions.<br>Incorporate complex tasks.<br>Provide students with worked-out examples. Focus on real-life scenarios. Include unsolved problems and incorrect solutions to problems to discuss critically and debate in groups to incorporate constructive controversy.<br>Provide limited feedback and guidance to learning tasks by the facilitator. Structure learning tasks in task classes.<br>During the group discussion give feedback on overzealous transfer.<br>Aim for mastery-approach goals, such as focusing on developing competence and attaining skills, rather than performance goals, by fostering positive interdependence.<br>Restructure course content for a holistic approach. Restructure course material to revise new material. Provide an overview, and each time revisit topics at a deeper level. Provide repeated experience with the same information but in different contexts.<br>Follow a whole-part approach for learning tasks, and order learning tasks in task classes. |
| Second intervention | All guidelines as indicated for the first intervention above still apply.<br>Students need to design and do an authentic task as a database project. |

**TABLE 3.5:** Interventions and guidelines applied in phase 3.

| Intervention | Description of guideline |
|---|---|
| First intervention | All guidelines as indicated in Table 3.3 were applied and the guidelines below were added to the intervention.<br>Focus on guiding students through inquiry activities first and do some problem-solving, instead of following a tell-first approach.<br>Give a variety of real-life, complex problems on various scenarios. Provide more worked-out examples, progressing in complexity. Combine groups to compare and debate their solutions to complex problems. Focus more on comparing and contrasting examples, to identify deep-structure similarities.<br>Administer knowledge surveys to students.<br>Include metacognitive questioning.<br>Match the level of SDL required to students' level of readiness, and make progression towards student-directed learning over a period of time.<br>Introduce collaboration scripts to inexperienced groups. |
| Second intervention | All guidelines as indicated above still apply. However, at this stage collaboration scripts are no longer required, as group skills have been acquired.<br>Students need to design and do an authentic task as a database project. |

SDL, Self-directed learning.

The course content was restructured for a holistic approach within the module outcomes, to first give a broad overview of all database objects. The focus then moved to a deeper understanding of each object, but still incorporating other objects. For example, although the theme of the lesson was designing tables, students would still be required to do a simple query, form and report on a database table that was designed.

In the second intervention, students were required to design a database as an authentic task. They could decide on any scenario that interested them personally, and they had to formulate the problem scenario and design a solution. The project was done individually, as time did not allow for doing the project in class time in cooperative groups. Opportunities were, however, created for students to discuss their projects in groups, present their scenarios, critically evaluate each other's designs and discuss challenges they experienced.

After analysing the data of the intervention in phase 2, the guidelines were refined to be applied in phase 3 (see Figure 3.1), to a different group of participants, which was registered for the same module.

In phase 3, a greater variety of complex problems based on real-life examples was given to groups, to help them recognise deep-structure similarities in problem scenarios, with the aim of far transfer. Greater focus was placed on matching the level of SDL to students' level of readiness. Students were provided with online links to knowledge surveys, to assist them in identifying their learning needs and improving metacognition. Collaboration scripts were initially issued to groups to reduce the extraneous cognitive load of deciding on transactive group activities. In the second intervention, no further guidelines were implemented. As in phase 2, students had to undertake a database project as an authentic task. At this stage, collaboration scripts were phased out, as students had gained experience of working in their groups.

## The implications of implementing guidelines on students' disposition towards lifelong learning

To discuss the results of the implications of implementing the guidelines on students' inclination towards lifelong learning, the results of the pre-TLO, post-TLO and qualitative data collection in phase 3, after the second design cycle, will be discussed.

When completing the TLO questionnaire, participants could rate themselves on a scale of 1 to 5. It was assumed that participants would have at least some qualities in each of the categories, and therefore the bottom value of the scale was given as 1. When analysing the responses, the scales of the questions were adjusted to range from 0 to 4, to align with the rubric-type questions in the questionnaire, which consisted of only four options, coded as 1 to 4.

### Results of the Transferable Learning Orientations tool in phase 3

Twenty-six ($N$ = 26) participants completed the pre-TLO in phase 3. It was found that the self-motivation category indicated poor reliability ($a$ = 0.197), and questions 1 and 5 were omitted. Thereafter, the Cronbach's alpha improved to 0.824. It however seemed that questions 1 and 5 worked against questions 2 and 3. Questions 1 and 5 indicated intrinsic motivation, while questions 2 and 3 indicated extrinsic motivation.

As students may have personal factors in their own individual contexts that motivate their learning, we did not want to exclude data obtained from questions 1 and 5 merely because of reliability factors. An additional scale to indicate extrinsic motivation was therefore added, which was determined by the average of questions 2 and 3 (still coded in reverse). The original scale of self-motivation was thus relabelled 'self-motivated_int' (intrinsic motivation), indicating the mean of questions 1 and 5 (see Table 3.6). Because questions 2 and 3 of the TLO were coded in

**TABLE 3.6:** Reliability of the Transferable Learning Orientations tool in phase 3.

| Category | Cronbach's alpha ($\alpha$) | Questions included | Questions omitted |
|---|---|---|---|
| Self-motivated_int | 0.526 | Q1, Q5 | |
| Self-motivated_ext | 0.824 | Q2, Q3 | |
| Learning belief | 0.537 | Q6, Q7, Q9, Q11 | Q8 |
| Self-efficacy | 0.826 | Q12(r), Q13, Q14, Q15, Q17 | |
| Transfer | 0.735 | Q18, Q19, Q20, Q22 | |
| Organisation | 0.600 | Q23, Q24, Q25(r), Q26, Q28 | |

reverse, a low mean for 'self-motivated_ext' indicated that participants were highly motivated by extrinsic factors.

The 'learning belief' category did not have an acceptable reliability and question 8 had to be omitted. Table 3.6 indicates the reliability of the categories of the adjusted TLO, the questions included and those that had to be omitted.

Table 3.7 shows the paired-samples statistics of the pre-TLO and the post-TLO. Twenty-four ($N$ = 24) participants completed both the pre-TLO and the post-TLO. It is evident that the mean scores in all categories improved.

The categories 'self-motivated_int' ($d$ = 0.38), 'self-motivation_ext' ($d$ = 0.51), 'flexible learner' ($d$ = 0.32) and 'makes connections' ($d$ = 0.33) all improved with a medium effect. These results indicate the possibility that participants were inclined to transfer knowledge and were less motivated by extrinsic factors. The categories 'confident' ($d$ = 0.04) and 'learns independently' ($d$ = 0.16) also improved, but with too small an effect. The improvements in the intrinsically motivated category 'learns independently' and 'confident' may also be an indication of their enhanced SDL disposition. Because a random sample from the population was not drawn in this study (see the section on 'Population and sampling'), the $p$-values were not relevant and were reported for the sake of completeness. However, emphasis had been placed on the interpretation of effect sizes.

Figure 3.3 depicts the improvements in the various categories of the TLO.

**TABLE 3.7:** Paired-samples statistics of the Transferable Learning Orientations tool in phase 3.

| TLO category | *N* | Mean (pre-TLO) | Mean (post-TLO) | Mean difference (post – pre) | Effect size (*d*) | *p* |
|---|---|---|---|---|---|---|
| Self-motivated_int | 24 | 2.2917 | 2.4792 | 0.1875 | 0.38* | 0.233 |
| Self-motivated_ext | 24 | 0.3958 | 0.6875 | 0.2917 | 0.51* | 0.045* |
| Flexible learner | 24 | 2.9375 | 3.0938 | 0.1563 | 0.32* | 0.226 |
| Confident | 24 | 2.8750 | 2.9000 | 0.0250 | 0.04 | 0.828 |
| Makes connections | 24 | 2.5000 | 2.7292 | 0.2292 | 0.33* | 0.046* |
| Learns independently | 24 | 2.4167 | 2.5167 | 0.1000 | 0.16 | 0.347 |

Effect size: *0.2 < $|d| \leq 0.5$; **$|d| > 0.8$; *p*-value: * $p < 0.1$.
TLO, Transferable Learning Orientations.

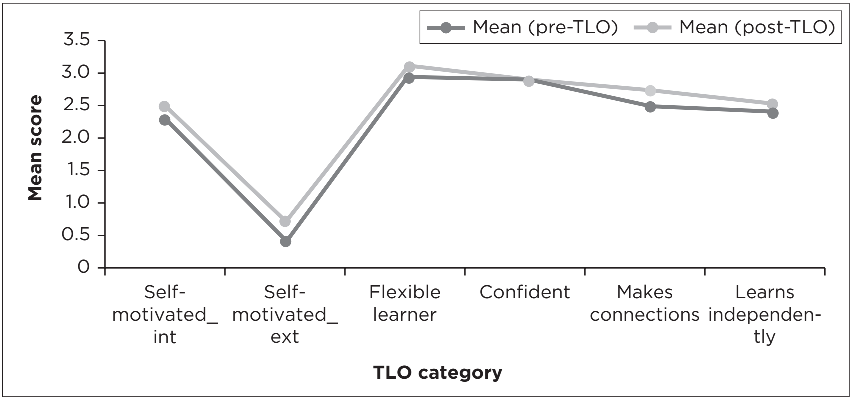



**FIGURE 3.3:** Mean scores of the pre-Transferable Learning Orientations tool and post-Transferable Learning Orientations tool in phase 3.

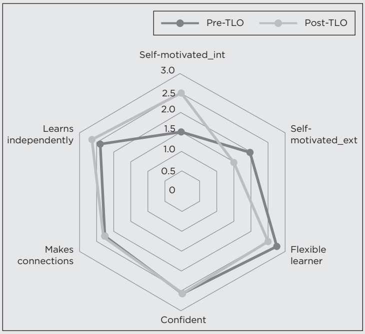
In the following section, spider diagrams of some individual results of the pre-TLO and the post-TLO will be discussed.

## ☐ *Spider diagrams drawn from the Transferable Learning Orientations tool results in phase 3*

In Box 3.1, spider diagrams of the results of some individual participants are given. Quotes from the open-ended questions are also provided to elucidate the averages of each category.

**Box 3.1** Spider diagrams from the pre-Transferable Learning Orientations tool and the post-Transferable Learning Orientations tool results in phase 3.

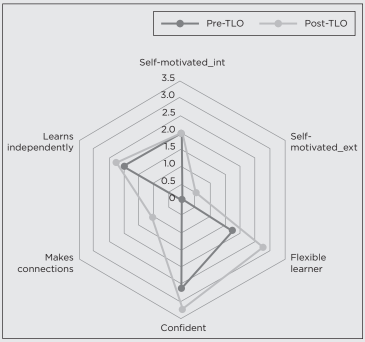
**P15 (student, 2018)**




**Learning belief / flexible learner:**
*Planning, set out the work in sequence, organise everything exactly. (pre)*
*I managed my time. (post)*
**Confident / self-efficacy:**
*Lack confidence in time management, how information will be passed on, and if I will understand or not. (pre) The work that I don't understand well can let me down. (post)*
**Transfer / makes connections:**
*Repetition, learn from memory. (pre)*
*Planning and time management. (post)*
**Learns independently:**
*Being organised and having goals is very important. (pre)*
*I planned and managed my time, to learn in full and set things out my way. (post)*
**Self-motivated_ext:**
*No quotes for this category.*

**Self-motivated_int:**
*The idea that I'll learn something new each time. (pre)*
*The way in which new work is learnt. (post)*

**P3 (student, 2018)**




**Learning belief / flexible learner:**
*I have control over extrinsic factors that can influence my academic performance. (pre)*
*I believe one doesn't have control over everything. Some days emotions are high, and thoughts wander. (post)*
**Confident / self-efficacy:**
*The module is very challenging. It's different and difficult, because I didn't have CAT at school. (pre)*
*Self-discipline and one must work for what you're looking for. This was by far the most difficult module I had in CAT. I had no prior knowledge. (post)*
**Transfer / makes connections:**
*I work hard and try to keep up to date. I try to learn by discovering new information. (pre)*
*A lot of problem-solving took place in this module. A lot of self-learning takes place, which forces you to pay attention and make your own connections. (post)*
**Self-motivated_ext:**
*To get an academic bursary and take the pressure off my mother. (pre)*
*Good results, and because I failed the first test. (post)*

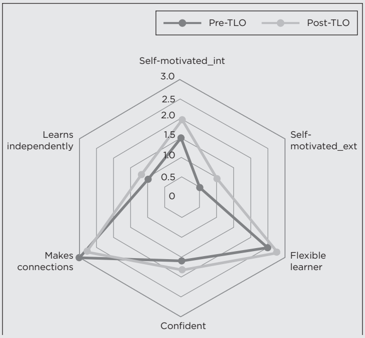
**Self-motivated_int:**
No quotes for this category.

**Learns independently:**
*I take it day by day and try not to make it too difficult. (pre)*
*I propose that more clarity be given in terms of what's expected and on what's going on in the module. (post)*

*Box 3.1 continues on the next page →*

**Box 3.1 (Continues...):** Spider diagrams from the pre-Transferable Learning Orientations tool and the post-Transferable Learning Orientations tool results in phase 3.

**P8 (student, 2018)**




**Learning belief / flexible learner:**
*I am fairly in control of the learning. Other factors, such as the noise in the hostel, cause trouble. (pre)*
*I had learning obstacles at home, noise, number of tasks in all subjects, obstacles in focusing and being disciplined. (post)*

**Confident / self-efficacy:**
*Lack of confidence in creating macros. (pre)*
*Lack of confidence in some parts of Access. (post)*

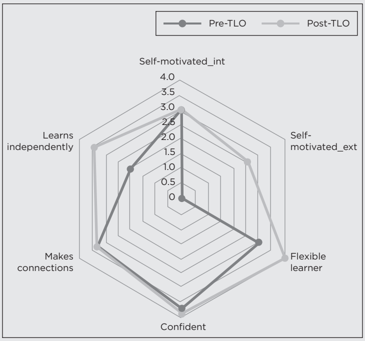
**Transfer / makes connections:**
*I applied problem-solving when doing tasks and practical teaching in schools. (pre)*
*Learning and doing problem-solving in groups. (post)*

**Self-motivated_int:**
*I am motivated by computer skills. (pre)*
*A heavy workload, but interesting. (post)*

**Self-motivated_ext:**
*I need to obtain my degree. (pre)*
*I need to finish my degree. (post)*

**Learns independently:**
*I planned tasks according to due dates. (pre)*
*Made notes and used checklists. (post)*

**P9 (student, 2018)**




**Flexible learner / learning belief:**
*I mostly have control over different factors in my life. (pre)*
*I definitely improved my time management. The more time I allocate to a task, the better I understand the work. (post)*

**Confident / self-efficacy:**
*I have enough self-confidence to know that I can attempt anything in this module. (pre)*
*Networks are difficult, but I know if I do my part, then I'll understand and enjoy them. (post)*

**Transfer / makes connections:**
*I created questions and problem scenarios for myself and tried to solve them. (pre)*
*I tried to let each module connect to other modules. It made sense to me if everything fitted together. (post)*

**Self-motivated_int:**
*I love this subject. I find it extremely nice. (pre)*
*I enjoyed it a lot and found it very informative. (post)*

**Self-motivated_ext:**
*One day I would like to be a successful CAT teacher. (post)*

**Learns independently:**
*I set goals for myself and did my best to reach them. (pre)*
*I made sure I had enough time to complete an assignment, and then I understood the work better and could work thoroughly through each question. (post)*

The first diagram in Box 3.1 depicts the results of participant P15. It can be observed that the score for the 'self-motivated_int' category improved, and that the score for the 'self-motivated_ext' category decreased. Although participant P15 was thus more intrinsically motivated, she was also motivated by extrinsic factors.

For participant P3 (see Box 3.1), improvements are noticed in most categories. Although participant P3's score for intrinsic motivation seemed to stay the same, her extrinsic motivation improved (the extrinsic motivation category was coded in reverse). Participant P3 can thus be described as being less motivated by extrinsic factors after the second intervention.

For participant P9 (see Box 3.1), a rounder shape is noticed after the second intervention, which indicates that participant P9 is more balanced in the various categories, and that she has thus addressed her initial self-reported weaknesses. The extrinsic motivation category also shows considerable improvement, which indicates that participant P9 is now much less motivated by extrinsic factors after the second intervention.

It is further noted that participants P3, P8 and P9 mentioned that they applied problem-solving skills.

In this section, the results of the TLO were reported on and the quantitative results were compared with the qualitative results of the open-ended questions. In the following sections, the results of the interviews will be discussed.

## Results of interviews

During the discussion, themes that emerged from the data will be represented visually by network views. The letter 'G' represents the groundedness of the node, or the number of quotations linked to the node (Friese 2012:140). The letter 'D' indicates the density of the node, or the number of codes that are linked to the node (Friese 2012:140).

Figure 3.4 depicts the results of the interviews related to the categories of the TLO that emerged from phase 3. Due to limited space, only the results of the interviews after the second intervention of phase 3 (see Table 3.2), will be reported.

Six participants accepted the invitation for interviews. Two participants from the no transfer group, three participants from the attempted transfer group, and one participant from the successful transfer group were interviewed.

Strong themes that emerged were the themes of learning independently (*G* = 14) and good self-efficacy (*G* = 11). Participants' comments were also related to making connections (*G* = 8) and being intrinsically motivated (*G* = 7). No comments were linked to the theme 'flexible learner'. Some comments were, however, related to the themes of low self-efficacy (*G* = 2) and extrinsic motivation (*G* = 3). The numbers allocated to participants, for example, P2d, do not correlate with the numbering indicated in the spider diagrams, as indicated in Box 3.1.

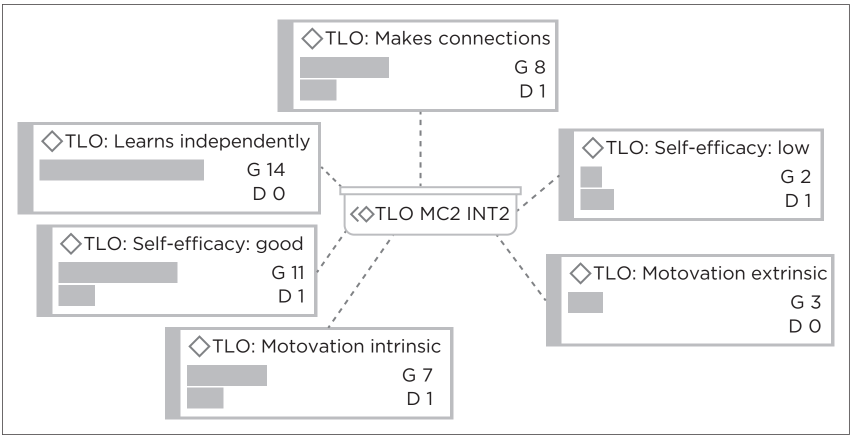



**FIGURE 3.4:** Qualitative results related to the Transferable Learning Orientations tool after the second intervention of phase 3 (*n* = 6).

Participants often reported that the implementation of the guidelines encouraged them to also learn independently (*G* = 14) and figure out unclear or difficult concepts:

> 'When I didn't quite understand, I took the textbook, and to see it more visually, I used YouTube'. (P2d, student, November 2018)

> 'When I struggle on my own, I am inclined to understand better when I sit on my own and figure it out myself. If I get it right, I remember it'. (P5d, student, November 2018)

From the data, having good self-efficacy emerged as a strong theme (*G* = 11). Participants reported that they felt confident about concepts:

> 'At the moment I more or less understand everything. I can do it. I can accomplish it'. (P2d, student, November 2018)

> 'I did a lot of formulas in this assignment [*the project*]. Yes, I'll be able to do it now'. (P5d, student, November 2018)

Comments made by participants P1d and P4d were linked to the theme of low self-efficacy (*G* = 2):

> 'I don't know if I understand'. (P1d, student, November 2018)

> 'So it's basically between "know," "being uncertain" and "struggle"'. (P4d, student, November 2018)

Participants were inclined to make connections (*G* = 8) to other scenarios:

> 'I tried to reason it out logically. I put myself in the scenario. For example, if a client were to phone me now, wanting to make a reservation, what would the procedure be? What steps would you follow?' (P5d, student, November 2018)

> 'I think like in organic chemistry, where carbon dioxide can have four connections'. (P4d, student, November 2018)

> 'I had to think for a while about how I'm going to do it, but it helped, because I could apply it in my own situation'. (P6d, student, November 2018)

All the participants, except for P4d, made comments that could be linked to intrinsic motivation (*G* = 7). Participant P5d put a lot of effort into her project, as she was working on a scenario that she was passionate about. Participants also mentioned that being prepared was for their own benefit, and that they placed less emphasis on doing activities for marks:

> 'I put in a lot of effort [*in the project*], because it will be nice if [*the users*] see it all. This database still required a lot of stuff, but I tried to make it as complete as possible'. (P5d, student, November 2018)

> 'I enjoy what we do in Access a lot, and then I can learn how to do it on my own, and then I can learn to apply it in the test'. (P3d, student, November 2018)

All comments linked to extrinsic motivation were made by participant P2d ($G$ = 3). She reported that she would rather do assignments if they counted for marks, saying 'I did research for the project, like I searched for an answer, because it counted for marks. I had to do it right' (P2d, student, November 2018).

In this section, the development of the guidelines was discussed and results of the TLO and of the interviews were reported on. Next, these results will be discussed and the research will be concluded.

# Discussion and conclusion

The order of discussion in this section will be according to the research aims of this research. Firstly, guidelines to develop DSDL in a database module in CAT education will be suggested, and thereafter, the implications of implementing the guidelines on students' inclination towards lifelong learning will be discussed.

## Guidelines to develop deeper self-directed learning

The outcomes of DSDL will not happen by chance, and they need to be deliberately fostered, by realising students' full potential as self-directed learners and deeper learners. Students should therefore be guided to determine their learning needs, focusing on transferable knowledge, to formulate their learning goals accordingly, to identify resources and collaborate with others, to apply critical thinking, to solve problems, to evaluate whether appropriate learning goals and transfer of knowledge have been achieved, and to be encouraged to persist in their learning until their goals have been met.

Guidelines to develop DSDL have been based on CLT and SCT while incorporating collaborative teaching–learning strategies, strategies to promote transfer, strategies to develop competencies in the cognitive, intrapersonal and interpersonal domains, and strategies to develop SDL. The instructional environment proposed to develop DSDL accordingly strives to reduce cognitive loads on the WM and to encourage connections with knowledge and schemas in the LTM. Learning should occur within social environments, where learners work in supportive groups to construct knowledge, execute complex tasks, think critically, solve problems, debate solutions and reflect on activities.

In Table 3.8, guidelines for developing DSDL in a database module in the CAT education class at university are indicated. The guidelines are numbered as 1 to 17. It is further indicated if a guideline is mainly intended to foster SDL, develop cognitive, intrapersonal or interpersonal competencies, or promote transfer, and whether the guideline is theoretically grounded in CLT or SCT.

In this section, guidelines were suggested to develop DSDL. The guidelines were based on the theoretical foundation provided for DSDL and on the results of data collected during interventions where the proposed guidelines were implemented. In the following section, the conclusions to the second aim of this research will be discussed.

**TABLE 3.8:** Guidelines to develop DSDL in a database module in Computer Applications Technology education.

| Guideline no. | Description of guideline | SDL | Cognitive | Intrapersonal | Interpersonal | Transfer | CLT | SCT |
|---|---|---|---|---|---|---|---|---|
| 1 | Restructure course content for a holistic approach and to revise material. Revisit topics at a deeper level. Provide repeated experience with the same information but in different contexts. | | ✓ | | | ✓ | ✓ | |
| 2 | Match the level of SDL required to students' level of readiness, and make progression towards student-directed learning over a period of time. | ✓ | ✓ | ✓ | ✓ | | | |
| 3 | Apply a collaborative teaching–learning strategy. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | Students are assigned randomly to groups to form heterogeneous formal or informal groups. Groups should be limited to four members. | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 5 | Aim for mastery-approach goals, such as focusing on developing competence and attaining skills, rather than performance goals. | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| 6 | Focus on guiding students through inquiry activities first and do problem-solving, instead of following a tell-first approach. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | Introduce collaboration scripts to inexperienced groups initially. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 8 | Encourage students to ask essential questions, and cultivate the habit of asking good questions. | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| 9 | Incorporate complex tasks. | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 10 | Provide students with worked-out examples, progressing in complexity. Examples must focus on real-life scenarios. Include unsolved problems and incorrect solutions to problems, to be discussed critically and debated in groups to incorporate constructive controversy. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 11 | Follow a whole-part approach for learning tasks. | | ✓ | | | ✓ | ✓ | |
| 12 | Include metacognitive questioning. | ✓ | ✓ | ✓ | | ✓ | | |
| 13 | Administer knowledge surveys to students. | ✓ | ✓ | ✓ | | | ✓ | |
| 14 | Provide limited feedback and guidance to learning tasks. | ✓ | ✓ | | | ✓ | ✓ | |
| 15 | During the group discussion, provide feedback on overzealous transfer. | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 16 | Give a variety of real-life, complex problems on various scenarios. Focus on comparing and contrasting examples. | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| 17 | Design and do an authentic task. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

SDL, self-directed learning; CLT, cognitive load theory; SCT, social constructivist theory.

## The implications of implementing the guidelines on lifelong learning

To determine the effect of deliberate implementation of the suggested guidelines on students' disposition to lifelong learning, the results of quantitative and qualitative data collection instruments were used (see Table 3.2). The following results were focused on (1) the results of the TLO, (2) the open-ended questions of the TLO, and (3) the results of the interviews.

In phase 3, after refining the guidelines, the results of the TLO (see Table 3.7) indicated improvements in all categories. The results of the quantitative data thus showed that participants' disposition to transfer competencies might have improved, which is promising. However, because of the small sample sizes, explanation about the possible improvement had to be obtained from the results of the qualitative data.

As observed in the spider diagrams (see Box 3.1), the results of the open-ended questions confirmed the quantitative results of the TLO. More rounded spider diagrams are also noted, which indicated that participants were more balanced in the various categories and have addressed their self-reported weaknesses. The results of the interviews indicated that participants transferred their knowledge to new scenarios. As depicted in Figure 3.4, the categories 'learning independently', 'good self-efficacy', 'making connections' and 'being intrinsically motivated' emerged as strong themes after the second intervention cycle of phase 3. When taking into account that only six participants were interviewed, the number of quotes associated with each theme indicate that individual participants made several comments that could be related to these themes. It can further be concluded that far transfer of competencies was implied, as participants mentioned that they would apply their knowledge to new scenarios, to other subject areas, and to the world. It can thus be concluded that the qualitative results substantiate the quantitative results that there is evidence of improved transfer of competencies which could have an effect on lifelong learning.

Self-directed learning was indicated as an important factor for lifelong learning (see sub-section 'Lifelong learning'). The categories of the TLO also correspond to SDL characteristics. According to Long (2000:22), self-directed learners will experience greater feelings of competence and confidence. Intrinsic motivation, good self-efficacy and learning independently have also been indicated as characteristics of self-directed learners (see sub-section 'Deeper self-directed learning').

From the qualitative data, it further emerged that participants were more intrinsically motivated (see Figure 3.4). Intrinsic motivation is often associated with curiosity and a desire for challenge (Long 2000; Ryan & Deci 2000a), both of which are characteristics of highly self-directed learners (Edmondson et al. 2012). Participants accordingly indicated that they enjoyed the challenges posed to them and that they were willing to find solutions to problems.

Participants' positive experiences thus boosted their self-efficacy, their confidence and their belief that they were able to succeed. As indicated by Long (2000), self-directed learners will experience enhanced feelings of competence and confidence, which should urge them to make more effort, set higher goals and be committed to them (Bandura 1993:118). It has already been indicated in Box 3.1 that participants frequently referred to problem-solving skills. According to Long (2000:18), metacognition is displayed by students who engage in problem-solving and evaluate and adapt strategies during problem-solving. Participants who improved their problem-solving strategies thus also might have improved their metacognitive skills and thus their competencies in the intrapersonal domain.

According to the above discussion, it can thus be concluded that the implementation of the guidelines to develop DSDL, improved students' inclination towards lifelong learning.

## Conclusion

The conclusion of this research is that students' inclination to lifelong learning improved after implementing the developed guidelines for DSDL. Although the guidelines were generically formulated to be applied in any appropriate context, more research is required in larger populations, in other subject areas and in other disciplines, before the proposed guidelines can be generalised.

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Chapter 4

# Lessons learnt in establishing a teaching presence in a cooperative blended learning environment: Facilitators' perspectives

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## Abstract

Online and blended learning (BL) are rapidly growing fields. These fields do require that students are more self-directed. Cooperative learning (CL) is a teaching strategy that enables students to become more self-directed. The role of the facilitator in a cooperative BL environment is of utmost importance. In a BL environment, the role of the facilitator is referred to as 'teaching presence'. When working with large groups, a single lecturer can scarcely fulfil the facilitation role effectively. The purpose of this study is to reflect on facilitators' experiences concerning their role in establishing a teaching presence in a cooperative BL environment to enhance SDL in large groups. The population for this study comprised 10 facilitators that were appointed to assist in the cooperative BL course, for which approximately 1200 students were enrolled. A qualitative study was conducted, where focus group interviews were conducted with the participants. Data were coded, sorted and analysed with ATLAS.ti™. The study has shown that the facilitators have the potential to assist in supporting large groups in cooperative BL environments, provided that they are sufficiently trained and equipped to support students.


**Keywords:** Cooperative learning; Cooperative blended learning; Self-directed learning; Teaching presence; Blended learning.

## Introduction and problem statement

With the increasing awareness of online and BL, it is important that we explore how students engage and learn in these environments successfully (Means et al. 2009; Shea & Bidjerano 2010). There is a longstanding perception that online education necessitates increased self-directednesss and self-sufficiency. Students in blended and online environments require a significant amount of persistence and willpower to face challenges that arise in these environments (Shea & Bidjerano 2012). Cooperative learning is a strategy used in teaching that can assist students with goal setting, planning, engaging in learning activities, and implementing reflective practices (Francom 2009). The role of the lecturer transitions to that of a guide and facilitator within such SDL environments. This creates an opportunity for students to take ownership of their own learning (Ellis 2007). When designing learning environments, the lecturer needs to guide students in recognising their learning needs and encourage them to take responsibility for their own learning (Bosch 2016).

The role of a lecturer becomes crucial in not only implementing CL in the classroom activities but also in enhancing SDL. When teaching large groups, one lecturer[3] cannot successfully fulfil this role. In a BL environment, this role of the facilitator[4] is referred to as 'teaching presence' (Shea & Bidjerano 2012). As the lecturer cannot single-handedly establish a teaching presence effectively in large groups, the use of facilitators becomes crucial because they can share this responsibility with the lecturer, and promote SDL.

The purpose of this study is to reflect on facilitators' experiences concerning their role in creating a teaching presence in a cooperative BL environment to promote SDL in large groups. The research question that arises is: What lessons can we learn from facilitators in establishing a teaching presence in a cooperative BL environment?

# Literature review

This section presents a literature review relating to the main concepts of this chapter. This includes a discussion on BL, SDL, CL, teaching presence and facilitating large groups.

3. The term *lecturer* refers to the appointed academic who is responsible for all academic matters of the course.

4. In this chapter, the term *facilitator* refers to the appointed student facilitators who assisted the lecturer in facilitating the online CL course.

## Blended learning

Blended learning has become increasingly important in higher education because of the flexibility it provides in learning (Mirriahi, Alonza & Fox 2015). Although there are a myriad of definitions for BL, most of them point out that it is a teaching and learning approach which integrates face-to-face interaction with some form of web-based teaching and learning (Ma'arop & Embi 2016). Blended learning draws on the advantages of instruction presented by means of face-to-face interaction as well as online learning, and allows the facilitator to take advantage of the best of both aspects (Aronson 2018).

Blended learning courses need to be designed carefully (Wang & Huang 2018). In online environments, activities need to be rethought and cannot merely be transferred from the traditional learning environment, and the impact of technology, in particular, should be taken into consideration (Ross 2012). Wang and Huang (2018) suggest that when designing the online environment, pedagogical, social and technical elements should be taken into account as guiding principles for the design. For this reason, in this project, the facilitator made use of the design model of Bosch, Mentz and Reitsma (2019) which incorporated these three elements.

When working in a BL environment, there is a shift in the role that technology plays. Previously it used to serve as a tool for teaching, now it acts as a collaborative learning space (Cooke 2013). In BL, the focus changes to a student-centred environment rather than a teacher-centred environment, with the emphasis on collaboration (McDonald 2012). In higher education, the learning management system (LMS) functions as a means to support interactions and connections between students, facilitators and content (Holmes & Prieto-Rodriguez 2018). Although CL has not been researched extensively in BL, it has proved to enhance SDL in face-to-face environments (Breed 2016; Mentz & Van Zyl 2018). In this chapter, we therefore explore the use of CL in a BL environment to promote SDL.

## Self-directed learning

An educational approach in which students take responsibility for their own learning is known as self-directed learning. Van Wyk (2017) refers to specific personal attributes that a self-directed student has. One of these attributes is being motivated to take responsibility for their own learning. Various skills are associated with SDL, these include determining and setting goals, finding appropriate resources, selecting suitable learning strategies and reflecting on the learning process (Ellis 2007). With the increased use of technology in the field of learning and teaching, the context of SDL has changed (Rashid & Asghar 2016) because it was first studied in the domain of adult education (Knowles 1975).

The involvement of a facilitator is an important component of SDL (Van der Walt 2019). In order to promote self-directed learners, the guidance of a more experienced person such as a facilitator can assist in directing students towards their own inquiry (Whisler, Makos & Anderson 2019). Also, the facilitator plays an essential role in facilitating 21st-century learning (Sang et al. 2018). Much research has been carried out on what skills students require in order to function effectively in the 21st-century workplace. There are varied opinions about exactly which skills are important (Mawas & Muntean 2018). However, the skills that tend to appear regularly include critical thinking, decision-making, creativity, problem-solving, teamwork, collaboration, digital literacy, communication, and interpersonal, self-directed, and lifelong learning skills (Holt & Brockett 2012; Mawas & Muntean 2018; Sang et al. 2018). Chu et al. (2017) categorise these skills into three knowledge domains, namely the skills necessary for digital literacy, for learning and innovation, and for life and career. There are various strategies that can be used to develop 21st-century skills.

## Cooperative learning

Cooperative learning is an instructional strategy that can enhance 21st-century skills. Cooperative learning involves small group and team learning in which students do tasks to strive towards a common goal (Alismail & McGuire 2015; Gates 2019; Jacobson-Lundeberg 2016). In particular, CL can assist with the development of critical thinking (Lee et al. 2016) and metacognition (Djamahar et al. 2018). Cooperative learning can equip students to interact, become more confident, and offer support to reach their goals (Oswalt 2003), which in turn can enhance their SDL skills. Cooperative learning entails a form of social involvement which can benefit students by learning together (Sharan 2010). Often group work is used as a teaching strategy, but these groups do not always follow the principles of CL (Kishore 2012). The five basic elements or components of CL that need to be incorporated in order for a group to be a cooperative group were proposed by Johnson and Johnson (1994). These elements are discussed in the next paragraph.

(1) *Positive interdependence* means that all group members are dependent on each other to achieve the desired goal. The whole group is affected if one member is not successful in doing his or her part of the task (Casey & Goodyear 2015). (2) *Individual accountability* indicates that all group members are responsible for mastering the work and doing their part (Astuti & Barratt 2018). (3) *Promotive interaction* implies that all members are responsible to help and provide feedback to complete the task. Members are expected to encourage each other to complete the task successfully (Gillies 2016). (4) *Interpersonal and small group skills* refer to interaction with each other by means of listening, expressing opinions, sharing views and accepting others' viewpoints (Casey & Goodyear 2015). (5) *Group processing* is concerned with reflecting on the group work. This implies that helpful actions are encouraged, and those that were not helpful are discarded (Sutherland et al. 2019). Not only should the lecturer and facilitator purposefully plan to include the elements of CL but he or she should also establish a teaching presence in the cooperative BL environment.

## Teaching presence

One of the most effective frameworks that outlines the actions and processes of knowledge construction in online and BL environments is the Community of Inquiry (CoI) framework (Shea & Bidjerano 2009). According to Shea and Bidjerano (2010:1722), the CoI framework distinguishes between three presences, 'teaching, social, and cognitive presence'. An additional presence, namely the learning presence that focuses on aspects of SDL and self-regulation (Bosch & Pool 2019) has emerged from the research carried out by Shea and Bidjerano (2010). When using CL as a teaching strategy in a BL environment, it is essential to understand that both the CoI framework and the principles of CL should complement each other in enhancing a teaching–learning experience. In this study, the focus was on exploring facilitators' experiences with regard to establishing a teaching presence. According to Anderson et al. (2001), teaching presence is defined:

> [*A*]s the design, facilitation and direction of cognitive and social processes for the purpose of realising personally meaningful and educationally worthwhile learning outcomes. (p. 5)

When establishing a teaching presence, three categories of indicators are highlighted as important, namely, 'instructional management; building understanding, and direct instruction' (Garrison, Anderson & Archer 1999:89; Szeto 2015:192). *Instructional management* refers to aspects relating to the lecturers' managerial roles such as course design, planning and administrative issues. *Building understanding* deals with establishing learner-centred approaches in the online environment, while *direct instruction* focuses on the lecturer's facilitation of the content and assessment practises (Garrison et al. 1999; Szeto 2015).

According to Garrison (2015), facilitators need to take various aspects into consideration in order to establish a teaching presence. The role of a facilitator should include aspects such as the following:

- administering educational changes
- promoting student engagement
- guiding the achievement of learning outcomes collaboratively and timeously
- having sufficient content and pedagogical knowledge

- being adaptable to accommodate students
- establishing a safe and comfortable social environment.

Garrison (2015) further states that teaching presence is a crucial aspect in the creation of learning experiences which foster critical and higher-order thinking within collaborative BL environments. There are various challenges presented to the lecturer when teaching large groups (Lynch & Pappas 2017), one of which is establishing a teaching presence.

### Facilitating large groups

Facilitating large classes has always been a cause for concern. Numerous strategies to deal with large groups have been investigated in the past, such as flipped classroom design (Danker 2015); small group learning (Lyon & Lagowski 2008); PBL (Bledsoe 2011) and augmented reality videos (Yip et al. 2019). Many of these studies make use of active learning strategies with the aim of increasing student engagement (Woods & Bliss 2016), fostering student interaction, promoting lifelong learning skills and eliminating student passivity (Beigzadeh 2016). Because of the positive outcomes of implementing active teaching and learning strategies, we decided to redesign an undergraduate course, based on the principles of CL, which has proved to enhance the above-mentioned skills.

## Course design

In the next section, the structure and course design of the relevant module are discussed.

### Background of the course

The course used for this study was the final year education course that focused on assessment and teaching and learning practices. There were 1200 students registered for the course. The group was split into smaller groups of 200–250 students; each group had one formal contact session of about an hour and a half per week in an auditorium-style lecture hall.

## The course structure

Previously, the course was presented in a traditional teacher-centred manner and the students were not actively involved in the learning process. For this reason, as well as an institutional priority to move towards BL modes of delivery and a focus on SDL, the lecturer decided to rethink and redesign the entire structure of the course. The redesign focused mostly on technology integration and the use of active teaching–learning strategies that can enhance SDL. The following components were considered in the redesigning of the course:

1. the contact sessions
2. the online learning platform
3. the online CL task.

### Contact sessions

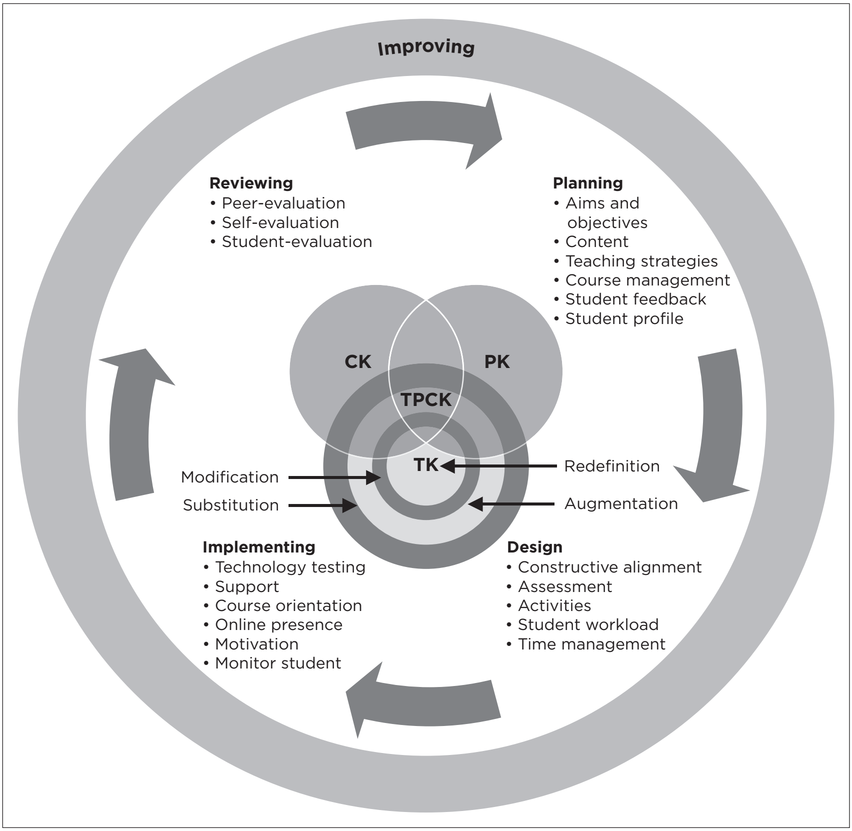
The contact sessions were presented by using a flipped classroom approach. Students were expected to prepare for the contact sessions by watching instructional videos and reading through selected resources. They also had to complete an online test through the LMS before coming to class. This assured that the students were prepared for class and could actively take part in class discussions and learning activities.

The lecturer made use of a CL approach where students worked in informal CL groups of about four students during the contact sessions. Because of the large classes, and the 'uncomfortable' auditorium-style setting of the venues, the group division was usually carried out informally by grouping students who sat near to each other. The main purpose of the contact sessions was to focus on the practical and authentic application of the theory that the students had prepared. Students were presented with real-life, ill-structured tasks that they had to complete in their CL groups. The lecturer ensured that all five of the principles of CL were present in the task design. It was also important to emphasise and explain to the students how these principles were integrated into the tasks. They were final year education students who are expected to use this type of activity in their own classes when they start teaching. Therefore, the lecturer chose a different CL strategy each week and included the theory on how to execute this strategy in their preparation for the contact session. This also helped with managing the large classes in that the students knew what was expected of them with regard to each class activity. The online platform that was used by the students for the flipped classroom approach is discussed in the next section.

## ☐ The online platform

The tertiary intuition uses an open-source LMS powered by SAKAI™. Students are generally familiar and comfortable with using the LMS because most lecturers use the LMS to some extent. The LMS was used for two main purposes, namely, (1) general course information and management, which is discussed in this section; and (2) as a platform for the online CL task. The design principles of the combined BL design model (Bosch 2016:79) were used to structure the online platform, and are discussed subsequently. The combined BL design model incorporates design principles from four models that focus on the integration of technology, namely, The Technological Pedagogical Content Knowledge model by Mishra and Koehler (2006), the multimodal conceptual model by Picciano (2009), the Substitution, Augmentation, Modification, and Redefinition (SAMR) model by Puentedura (2012), and the BL design process model by Bath and Bourke (2011) (Bosch 2016). Figure 4.1 illustrates the five phases of the model:

1. Planning.
2. Design.
3. Implementing.
4. Reviewing.
5. Improving.




*Source*: Bosch (2016:79).
CK, content knowledge; PK, pedagogical knowledge; TK, technical knowledge; TPCK, Technological Pedagogical Content Knowledge

**FIGURE 4.1:** The combined blended learning design model.

The next section focuses on the way in which each of these phases, with their relating design components, was implemented in the module.

## Planning phase

As suggested by the combined BL design model, the first phase in redesigning the course involves *planning*. The design components that need to be considered in the planning phase are (1) aims and objectives, (2) content, (3) teaching strategies, (4) course management, (5) student feedback, and (6) student profile. The manner in which the online platform attended to each of these components is discussed shortly.

## ☐ Aims and objectives

An e-guide was designed for the module and presented to students through the LMS. In the e-guide, a page dedicated to the communication of module information was made available to the students. The course's aims and objectives (module outcomes) as well as the assessment criteria were communicated to the students on the e-guide through the LMS.

## ☐ Content

In the process of redesigning the course, the lecturer had to evaluate the resources that were previously used for the course. A variety of online and e-resources were made available on the e-guide. Students were also encouraged to find their own resources – especially when completing the online CL task.

## ☐ Teaching strategies

A variety of CL strategies were used during contact sessions. As seen in Figure 4.2 and discussed in the section on 'Course design', a different CL strategy was selected for each contact session and students were expected to watch videos on the execution of these strategies before coming to class.

## ☐ Course management

The structure of activities, especially with regard to the online CL project, was communicated to students on a separate page in the e-guide. The lecturer and students agreed on some basic, informal class rules during the introductory contact session.

**Preparation**

**Texbook: Chapter 1**

**Chapter 2**


**Additional reading material:**

Study unit 1
Slide share on productive pedagogies framework
Productive pedagogies.pdf
Video on teaching philosophy.

**Cooperative learning strategy for this week:**
**Think-pair-share**

- https;//youtu.be/KAPyC-NrUS8
- https;//WWW.youtube.com/watch?v=wW87rihT38l&t=13s
- https;//WWW.youtube.com/watch?v=YchexU5NVNA

**FIGURE 4.2:** Example of links to resources on e-guide.

## Student feedback

Students were given the opportunity to give feedback on teaching strategies on a weekly basis. A QR-code that was linked to a Google form was displayed in each contact session. The students had to write a #hashtag, together with an emoji, to describe their class experience. This helped the lecturer to have a quick view of the overall experiences of students. In the online CL project, the students were expected to give feedback on tasks that required of them to compare, challenge and reflect on each other's work.

## Student profile

Although these were final year students, they did not have much prior experience in CL and BL because most of their courses were presented in a traditional face-to-face manner. They were, however, familiar with the use of the LMS; therefore, the LMS was used as the main online platform. All the students had Wi-Fi and computer access in the on-campus computer labs. The students presumably had some experience in the use of technology for learning.

## Design phase

In this section, the design phase is described in terms of how constructive alignment was implemented, the assessment as well as the activities that took place in the module, and how the workload division was performed.

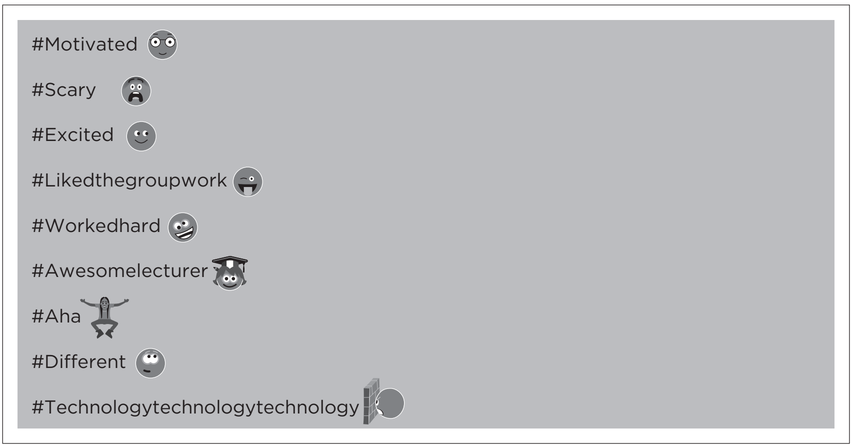



**FIGURE 4.3:** Example of #feedback.

## Constructive alignment

The principle of constructive alignment was followed to ensure that the teaching and learning strategies as well as the assessment activities were planned in a way that would assist the students to reach their course aims and objectives.

## Assessment

The assessment criteria were made available to the students. All the personal assessment tasks and online tests were made available at the beginning of the semester and the due dates were communicated clearly. Students then had the opportunity to complete the tasks in their own time and at their own convenience. Students also received feedback through the LMS when the online tests were completed and received notifications via the LMS to remind them of due dates. The online CL task is discussed in the next section.

## Activities

As described in the section on 'Course design', most of the class activities, as well as the online project, made use of CL as an active teaching strategy. Activities were carefully planned to ensure the inclusion of five CL elements. All the activities were designed to ensure that students understood the real-life implication and application of the theory they had to prepare for contact sessions.

## Student workload

To compensate for the time that the students had to spend online, especially while doing the online CL task, the number of scheduled contact sessions was reduced. The lecturer encouraged the students to use the 'scheduled' class time to work on their online projects.

### Time management

Although due dates for assignments, tests and projects were given to students at the beginning of the semester, they were still expected to set their own goals and timelines to manage their progress.

## Implementing

The combined BL design model suggests that certain aspects that should be in place for the course can be implemented. The design components that will help to put everything in place are technology testing, support, course orientation, online presence, motivation, and monitor student.

### Technology testing

As the online CL environment was quite unfamiliar to the students, the lecturer tried to use technologies that were familiar to them. The LMS with which they were familiar was used to a large extent for the online component. In addition, for the online CL project, Google Docs was used. Some other basic technologies such as the use of email and basic browsing and searches were also used.

### Support

The advantage of having the best of both an online and face-to-face environment was evident in the BL course. Not only was the lecturer able to spend face-to-face time with the students during and after contact sessions, as well as be available in regular consultation hours, the facilitators also were available to support students in their online CL project.

### Course orientation

During the first contact session, the lecturer explained the course structure and navigated the students through the layout of the

LMS. The course aims and objectives, assessment criteria, due dates and student expectations were also communicated to the students.

## ☐ Online presence[5]

Establishing an online presence was one of the most challenging aspects to incorporate in the online environment. Given the large groups of students, and the fact that they should be monitored, guided and assessed continuously while doing the online CL task, it was impossible for the lecturer to fulfil this role on their own. After applying for project funding from the institution, the lecturer was able to appoint 12 online facilitators to support and guide the CL groups in completing online CL tasks. The details are discussed in the next section.

## ☐ Motivation

Students were constantly motivated by the lecturer during the contact sessions. The facilitators were also expected to communicate with the students on a regular basis and encourage them to continuously work on the tasks. In the online CL task, one of the group members had the specific role to motivate their group members.

## ☐ Monitor students

The online tests were a way through which the lecturer could monitor student participation. The online facilitators also played a major role in this by monitoring participation and commenting on the group members' work in the online CL task (see Sub-section 'Cooperative learning').

5. In the model of Bosch (2016), reference was made to *online presence*, but in this chapter, we refer to the same concept as *teaching presence.*

## Reviewing

Elements of reflection were also built into the course. Students had to reflect on their own work and the work of others – this mostly happened within the online group task, but also as part of the CL class activities. Students also reflected on class activities (see Sub-section 'Activities') as well as completed a formal course evaluation once the course was completed. The lecturer also did some self-reflection and scheduled reflective sessions with online facilitators on the successes and failures of the course structure.

## Improving

The lecturer will take into consideration the student, peer, self- and facilitator reflections regarding the course structure when refining the course for implementation in the next academic cycle.

## The online cooperative learning task

The third component of the course design was the online CL task. This online task contributed to 50% of the participation mark for this course. To design successful CL tasks, the five elements (see 'Literature review') of CL must be visible. The elements were integrated throughout the task as indicated in the sections below. The structure and components of the group task are discussed shortly.

## Group allocation and sizes

The students were divided into random groups of seven people per group, and there was a specific role allocated to each student. The reason for the larger group sizes was to try and minimise the number of groups that needed to be facilitated because there was funding to appoint 12 facilitators only.

## The task platform

A separate course page was created for each of the groups through the LMS. Only the selected group members plus their facilitator had access to this page. A Google Doc was embedded on that page and the *Announcement, Resources and Chat* tools were made available to the group members for the purpose of communication and sharing of resources.

## Instructions and documentation

Clear instructions on how to contact their fellow group members and what to do, even before they started with the actual task, were posted on the course site of the LMS. The actual assignment and assessment criteria in the form of a marking rubric were also made available. The instructions were not only given in written format but also as a voice over PowerPoint presentation. The lecturer also made videos showing the students exactly how to access the group's LMS page, how to log into a Google account and how to work on a Google Doc. Figure 4.4 illustrates the instructions given to students on the eFundi page with regard to the online CL task.

## Group communication

Group members were expected to communicate (interpersonal and small group skills) in the *Chat* tool through the LMS. They were allowed to use WhatsApp as a communication medium if the facilitator agreed to join the chat group in order to monitor the communication. These two platforms were mainly used to communicate administrative matters. For the academic contributions, discussions (promotive interaction) and reflections, the students had to make use of the *comment* functionality in Google Docs (group processing). Students had to comment on each other's contributions and make suggestions to better the quality of the task.

## Assessment of the task

The final task adds up to a total of 70% for each student (positive interdependence). For the remaining 30%, each role had specific requirements to fulfil (individual accountability). These smaller

**Pre-assignment PERSONAL activities**

**Step 1:** Check  if you seen **ONE**
'Online project group XX' site on your eFundi.

**Step 2:** If you see **MORE THAN ONE** or **NOT ANY**
**group site** - Click on the link below
to fill in the ***'Problem with groups'*** form.

**Click here to fill in the form**

**Due date: Friday 1 March 12:00**

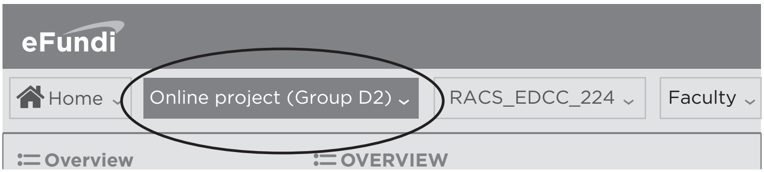



**FIGURE 4.4:** Example of instructions.

tasks were evaluated continuously by the facilitators. Therefore, the students who did what was expected of them also in terms of their role fulfilment would have received higher marks than those who were not actively involved throughout the process.

## ☐ Role division

Each group member was allocated a specific role that had specific role descriptors (tasks) that needed to be fulfilled. These roles and a short explanation of role descriptors are as follows:

- the group leader – managing the group and communicating regularly with the facilitator
- assistant group leader – managing time and work distribution as well as assisting with regular feedback

- motivator – encouraging and motivating group members
- communication and social skills person – facilitating group coherence and monitoring member involvement
- critical thinker – ask critical questions and assisting the group to focus and reach the outcomes
- technical officer – dealt with technical aspects of the task
- quality officer – ensuring the logical flow of argumentation and correct referencing.

Figure 4.5 illustrates the role description of a group leader. Every role had a specific colour allocated to them, which they had to use when typing in the Google Doc. This made it easier for the facilitator to monitor the progress and contributions of each of the group members. Facilitators monitored and evaluated the contribution of each group member continuously. The marks they received for this section added up to the 30% of the total marks for the task.

| Group loader (1) | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Timeous submission of planning, reflection's and final task | | | | | |
| Regular check-ins with the facilitator to track the group's progress | | | | | |
| Ensure that group members fulfill their roles effectively | | | | | |
| Continuous contribution to the google doc | | | | | |
| Quality and creativity of contribution | | | | | |
| Visible communication and interaction with other group members | | | | | |
| | | | | | Subtotal = 30 |

**FIGURE 4.5:** Example of role requirements (group leader[s]).

## Facilitators

There were 12 facilitators allocated to this module to assist the lecturer in monitoring, assisting and facilitating the online CL task. These facilitators were full-time postgraduate students with knowledge and skills that equipped them to do the task. As far as possible, the lecturer allocated groups to the facilitators that had the same field of specialisation as the facilitators. Each facilitator had about 15 groups to facilitate. A training session was held with the facilitators, where the lecturer discussed all the essential information relating to the task, their role as facilitators, and basic information about CL and SDL. We agreed on the best practices, and the facilitators were required to check in with the lecturer on regular basis.

# Research design and methodology

This study was viewed from an interpretive paradigm. The focus of interpretivism is on interpreting, understanding and describing experiences. Qualitative research is concerned with making sense of how people construct meaning, that is, the meaning that people attach to experiences they have (Creswell 2014; Merriam 2009). This study was performed by using a basic qualitative research design.

The population of this study was the facilitators that were allocated to facilitate the online CL task of the final year Assessment and Teaching and Learning course. The participants, therefore, were 10 of the 12 facilitators who gave informed consent to take part in the study. The data gathering method for this study was three semi-structured focus group interviews conducted by the researchers. The participants were given three time slots and according to their preferred time slot, three groups were created for the focus group interviews. The interview questions were open-ended and allowed the participants to share their experiences of facilitating the course. Data were coded, sorted and categorised into themes by means of the Computer-Assisted Qualitative Data Analysis Software package, ATLAS.ti™. The data from the interviews were analysed according to the process of qualitative analysis as suggested by Creswell (2014). We used an inductive process of data analysis and both researchers coded the data. The data were then sorted and discussed according to the themes that emerged during the data analysis process. From the interviews, 117 quotes were identified and categorised into 28 codes. Three focus group interviews were considered to be sufficient. We achieved data saturation in the third interview because no new insights with regard to the study were evident.

The trustworthiness of this research project was assured by (1) verifying the raw data, and (2) co-coding of the data. Although the interviews were transcribed by a third party, the researchers verified the accuracy of transcriptions. Both researchers co-coded the data and the two data sets were then compared to ensure the quality and consistency thereof. Ethical clearance for this research project was approved by the faculty's ethical committee. Only facilitators that signed the informed consent were interviewed, and they agreed that their data could be used in writing this report.

# Findings

The findings from the semi-structured interviews with facilitators are presented under the themes of CL, use of technology, SDL, and the role of the facilitator in relation to establishing a teaching presence.

## Cooperative learning

In this section, aspects relating to CL are discussed.

## Group selection

The group size was a concern. One facilitator felt that the groups were too large. There was also some debate amongst the facilitators concerning the best group selection strategies. Some expressed that the students found it challenging to work with strangers:

> 'I think the problem was that the students did not know their fellow group members and therefore it was difficult for them to argue and reason with strangers.' (Participant 6[1], facilitator, 31 July 2019)[6]

Participant three agreed with participant six in this regard. Another facilitator mentioned that students in groups selected by the lecturer delivered a higher quality of work:

> 'It is not friends that will chat socially about the task, but they interact more professionally when they do not work with their friends.' (Participant 1[3], facilitator, 07 August 2019)

Participant 2 preferred lecturer-selected groups because:

> 'When students work with friends, they assume that if they do not do their part, someone else in the group will do it for them.' ( Participant 2[3], facilitator, 07 August 2019)

Literature also presents varied opinions with regard to group selection. Healy, Doran and McCutcheon (2018) promote the student self-selection of groups, whereas Jacobs (2017) believes that students often prefer to do self-selection of groups, yet this opposes the CL principle of grouping heterogeneously, which can assist with learning and social cohesion. McCrea et al. (2016) point out the pros and cons of both methods of group selection. The findings of this study, therefore, cannot resolve the debate of student self-selection versus lecturer selection of groups.

6. In the section on findings, we refer to the direct quotes of the participants in the three different interviews as follows: Participant 6(1), facilitator, 31 July 2019. In this example, Participant 6(1) refers to the 6th participant in the first interview, the occupation/role that the participant fulfils is facilitator and the date refers to the date when the interview was done.

## Role division within the task

The intention was that each role contributes to the Google Doc in a specific colour, but the facilitators reported that this did not always take place, which made the monitoring of roles and evaluation of continuous contribution of the document difficult for them to carry out. The facilitators were tasked to not only continuously evaluate the roles of the students but also to evaluate the final task. They found it easier to evaluate the final task than to do the continuous role evaluation. The reasons suggested for this were that students did not always stick to their allocated role; students did not always use the allocated colour on the document; and group leaders did not always submit their weekly report.

## The elements of cooperative learning

The task was designed with the intention of promoting the five elements of CL. The facilitators viewed their opinions with regard to the success with which this was performed.

### *Individual accountability*

Individual accountability focuses mainly on two aspects, namely, (1) students' responsibility towards their own learning, and (2) responsibility for assisting the other members of the group to learn (Astuti & Barratt 2018). It was clear from the facilitators' comments that the students initially only focused on their own contributions and fulfilment of their roles, but later were more aware of the group's progress and success. Participant 3 reported that because of the subdivisions of the task as well as the timeline, initially students felt responsible for their own learning and towards the end of the task, felt the need to also take responsibility for assisting the other group members to successfully complete the task:

> 'I think that it was because the task was divided into different sub-sections. Each group member could work on a specific section of

> the task on their own, however towards the end they all had to work together. The timeline caused the students to start as individuals and then at the end they worked together.' (Participant 3[3], facilitator, 07 August 2019)

One facilitator requested that her group members informally evaluated each other on a weekly basis. She reported that this assisted with the individual accountability:

> 'This worked well, because if you do not do your work, then you will not get good marks. You cannot only rely on the rest of the group.' (Participant 1[2], facilitator, 05 August 2019)

### ☐ *Positive interdependence*

Positive interdependence refers to the dependence that group members have on each other in order to achieve the goal. Their success is dependent on the manner in which they coordinate their efforts (Casey & Goodyear 2015). The facilitators could clearly identify this element in the interaction of group members and agreed that group members, in general, worked well together and were reliant on each other to successfully complete the task:

> 'I think the groups that realised that they are dependent on one another, found the task to be much easier than the groups that decided to divide the work among each other and only take responsibility for that. I also had fewer complaints from those groups [*the groups that were dependent on each other*], while the other groups regularly squealed on each other.' (Participant 1[3], facilitator, 07 August 2019)

The facilitators also indicated that the role division assisted in promoting positive interdependence. The use of different coloured texts, in particular, assisted the facilitators in identifying positive interdependence amongst students, for example:

> 'You did not only see the red part in a specific paragraph, but also in between the other colours. This showed me that the group members

> did not only do their own section, but added to the other group members' work.' (Participant 1[2], facilitator, 05 August 2019)

### ☐ *Promotive interaction*

Promotive interaction refers to the way in which group members exchange and challenge the ideas of each other. This involves motivating each other, sharing ideas and resources, and celebrating the success of the group (Gillies 2016). One of the roles in the group was that of a critical thinker, whose job was to critically question and challenge group members to reflect on their work. The facilitators noticed that other members of the group did not necessarily reflect critically on others' work because they thought it was the responsibility of critical thinker. Although we tried to stimulate the elements of promotive interaction in the role description of all group members, this did not realise as we hoped it would.

### ☐ *The appropriate use of social skills*

Group members need to be taught social skills essential for members with different backgrounds, skills and personalities (Gillies 2016). As was the case with promotive interaction, the use of social skills was reported to be more evident in the informal chat platform of WhatsApp:

> 'Most of them communicated on WhatsApp … They were not scared to talk to each other on WhatsApp and told each other to do this and that.' (Participant 5[1], facilitator, 31 July 2019)

The facilitators reported that the students were comfortable in communicating with each other. One of the facilitators made use of an introductory activity to assist students with getting to know each other and with their interactions:

> 'For example, for students to get to know each other, you can let them do an icebreaker online. I let them start with an icebreaker where they had to say what animal they associate themselves with and why.' (Participant 5[1], facilitator, 31 July 2019)

## ***Group processing***

Group processing was a difficult element to be incorporated successfully. It involves reflection on the working of the group and celebrating successes (Sutherland et al. 2019). As part of the task, students were expected to critically reflect on each other's work in order to produce a quality end product. The facilitators indicated that students had difficulty reflecting on the other members' contributions, especially in an online environment, with statements like '[b]ut I could see that they were not that critical about each other's contributions' (Participant 1[2], facilitator, 05 August).

The facilitators suggested that a time be scheduled where students can reflect face-to-face rather than online. Participant 5 suggested

> 'One can schedule a face-to-face session where students come to class and talk about improvements.' (Participant 5[1], facilitator, 31 July 2019)

Participant 1 added that the facilitators should be present at such a session to assist students with the reflection process. The facilitators agreed that there was a form of reflection, but what they reflected about was more superficial, for example:

> 'Add more photos.' (Participant 1[2], facilitator, 05 August 2019)

> 'We should jazz-up the memo.' (Participant 2[2], facilitator, 05 August 2019)

There were, however, a few exceptions where facilitators reported that students did critically reflect on the content in the task:

> 'I also saw that some of the students did critique others' work and recommended changes, but it wasn't everyone.' (Participant 3[1], facilitator, 31 July 2019)

## Use of technology

The use of technology in BL environments is essential, but can also be an obstacle depending on students' skills and experience. The main platform for the project was Google Docs. In general, the facilitators agreed that the students did not have many questions relating to the technology. One participant felt that initially students found the platform of Google Docs unfamiliar and challenging, but with time they managed to master the technology in order to perform the task:

> 'I think it was a success in the end. I think they found it challenging, but they succeeded in the end.' (Participant 2[2], facilitator, 05 August)

Concerning the LMS (eFundi), students seemed to be comfortable and did not experience any challenges.

One of the challenges in terms of technology was that all students did not have access to technology at home, which influenced one of the basic benefits of BL, namely working anytime at any place (Wang & Huang 2018). They also suggested that students might benefit from more extensive technology training before starting the task. However, one of the participants stated:

> 'This was not only a task. For me it was a key to the technological era that students can implement in schools when they start teaching … the technology provides a creative way in which to do tasks.' (Participant 3[3], facilitator, 07 August 2019)

## Self-directed learning

The facilitators were asked whether the course assisted students to become more self-directed or not, and if so, what SDL skills were evident in their interaction with the students. Most of the facilitators reported that students did plan, allocate tasks and set goals for the group at the beginning of the task:

> 'I had groups that compiled a table which said who should do what, when even before they started the task … They themselves said that "this theme must be completed by that time".' (Participant 1[1], facilitator, 31 July 2019)

Other facilitators echoed this idea of students doing their own planning and setting their own goals:

> 'So they set goals for each other, which was good. They did not just leave it for the last minute.' (Participant 1[2], facilitator, 31 July 2019)

They also commented on the functioning of the 'motivator' role and its effect on the progress of the task:

> 'My groups also had a table with due dates and goals. The "motivator" used that to encourage the group members by saying "Okay, we have achieved this goal, let's go on to the next one".' (Participant 2[2], facilitator, 05 August 2019)

When asked whether the course structure encouraged students to be more self-directed, their responses were as follows:

> 'Yes, because they must read for themselves what needs to be done and do not get spoon-fed in class. I don't think it instantly made them more self-directed, but I think this was a step in the right direction.' (Participant 3[1], facilitator, 31 July 2019)

> 'In the beginning there were a lot of questions. I could clearly see that the questions got less and that the questions focused more on content which means that they figured things out for themselves.' (Participant 1[2], facilitator, 05 August 2019)

> 'They came right and where they struggled, they helped and learnt from each other.' (Participant 2[2], facilitator, 05 August 2019)

The facilitators also reported that the project provided the students the opportunity to take responsibility for their own learning:

> 'I think they are more used to working independently and think for themselves after doing this course.' (Participant 1[3], facilitator, 07 August 2019)

> 'They asked me how to insert images into the Google Doc. I could not help them immediately and when I followed it up, they said: "Don't worry, we've already figured it out".' (Participant 2[2], facilitator, 05 August 2019)

## The role of the facilitator in relation to establishing a teaching presence

The aim of this study was to reflect on the experiences that facilitators had with regard to their role in establishing a teaching presence within large groups. This project was designed in a cooperative BL environment with the aim of enhancing students' SDL. The facilitators were asked to reflect on their role in establishing this teaching presence in a large group. This discussion focused on the manner in which the facilitators were able to establish a teaching presence through the three categories of indicators as originally presented by Garrison et al. (1999). Secondly, we established to what extent the facilitators were aware of the aspects that a facilitator should take into consideration when establishing a teaching presence as discussed in the Sub-section on 'Teaching presence' (Garrison 2015).

### Categories of teaching presence indicators

As discussed in the Sub-section on 'Teaching presence', Garrison et al. (1999:89) and Szeto (2015:192) point out that teaching presence focuses on three aspects, namely, 'instructional management, building understanding and direct instruction'. Instructional management was performed by the lecturer in the manner in which the course was planned and designed. A part of instructional management is dealing with administrative issues. These issues that arose in the course were addressed by both the lecturer and the facilitators. The facilitators agreed that they dealt with a large number of administrative queries:

> 'We dealt with a lot of admin questions. They would ask: "Is this on time? Is that right? Where can I find that?"' (Participant 2[3], facilitator, 07 August 2019)

Building understanding is concerned with establishing learner-centred approaches in the online environment (Garrison et al.

1999; Szeto 2015). This was also partly performed by the lecturer through implementing learner-centred approaches such as the flipped classroom approach (Danker 2015) and CL (Wright 2011), and partly executed by facilitators. The facilitators reported that:

> ‘They worked well on their own, we did not need to spoon-feed them all the time.’ (Participant 2[2], facilitator, 05 August 2019)

> ‘They were more used to working independently and thought for themselves rather than asking us for help all the time.’ (Participant 1[3], facilitator, 07 August 2019)

Direct instruction, which involved the facilitation of content and assessment practices (Garrison et al. 1999; Szeto 2015), was also implemented by both the lecturer and the facilitators. In general, the facilitators felt equipped to deal with subject-specific queries. This could be because of the fact that the group allocation was made according to the facilitators’ field of specialisation and expertise:

> ‘I mainly had to facilitate Foundation Phase groups and I felt comfortable with that since I also studied Foundation Phase.’ (Participant 2[2], facilitator, 05 August 2019)

There were cases where facilitators were allocated groups to facilitate in a subject area outside their expertise. They did report that they coped well with the facilitation – one of the reasons was the nature of the task, which focused on lesson planning for school subjects – and students presented the content in a manner that is easy to understand and navigate:

> ‘I had a Maths group and although it was not my major subject, the students explained the worksheets and content so clearly that I had no problem in understanding. So I was quite comfortable.’ (Participant 1[2], facilitator, 05 August 2019)

The facilitators were involved in the assessment of each individual’s role fulfilment as well as assessing the final tasks of the students.

**TABLE 4.1:** Facilitators' establishment of a teaching presence.

| Aspects to consider when establishing a teaching presence | Examples forming the interviews |
|---|---|
| Administering educational changes | I feel my role as facilitator was to bind everything together. (Participant 4(3), facilitator, 07 August 2019)<br>I wanted to be approachable. The students knew that I had an open-door policy and they could ask me if they needed help. (Participant 1(2), facilitator, 05 August 2019) |
| Promoting student engagement | I encouraged them to communicate on WhatsApp because it was easier for them. (Participant 4(3), facilitator, 07 August 2019)<br>I asked them every now and then if they needed help with anything and that they should let me know if they did [need help]. (Participant 1(2), facilitator, 05 August 2019) |
| Guiding the achievement of learning outcomes collaboratively and timeously | I could see that they worked together well through the colour coding they used on the Google Doc. (Participant 1(2), facilitator, 05 August 2019)<br>I encouraged my groups to develop timelines so that everyone knew when what should be done. (Participant 1(2), facilitator, 05 August 2019) |
| Having sufficient content and pedagogical knowledge | It was easy for me (to facilitate the content) because the task was so well structured. (Participant 4(3), facilitator, 07 August 2019)<br>I really felt equipped because I know I am knowledgeable about the subject. (Participant 2(2), facilitator, 05 August 2019)<br>Where I was not familiar with the subject content, I referred to the curriculum documents for guidance. (Participant 1(3), facilitator, 07 August 2019) |
| Being adaptable to accommodate students | I communicated formally via the LMS, but answered questions informally on WhatsApp all the time. (Participant 6(1), facilitator, 31 July 2019)<br>I spoke to the group leader regularly. (Participant 4(1), facilitator, 31 July 2019) |
| Establishing a safe and comfortable social environment | For example, for students to get to know each other, you can let them do an icebreaker online. I let them start with an icebreaker where they had to say what animal they associate themselves with and why. (Participant 5(1), facilitator, 31 July 2019) |

LMS, learning management system.

### Aspects to consider when establishing a teaching presence

Table 4.1 presents the aspects as suggested by Garrison (2015) that can assist in establishing a teaching presence with examples from the interviews with the facilitators.

The comparison of the aspects suggested by Garrison (2015) with the interview data served as a means to assess whether the facilitators were able to incorporate these important aspects in their facilitation or not. The interview data were able to suitably support each aspect described, which indicated that facilitators in this study successfully incorporated various aspects in creating a teaching presence.

## Discussion of findings

The involvement of facilitators proved to be useful if working with large groups in a cooperative BL environment. The facilitators proved to be successful in assisting the students with content-related queries. The following main aspects were highlighted in the study:

1. strict guidelines need to be in place before the start of the course to ensure that all students receive the same quantity and quality of feedback from facilitators
2. intensive training needs to be provided with facilitators in which the subject content, course goals and facilitator guidelines are dealt with in detail.

Both these aspects were incorporated in this study and proved to be successful.

## What lessons have we learnt?

The lecturer is the primary person who takes responsibility for the management of the day-to-day tasks and success of the module. However, because the class is made up of such a large number of students, facilitating and implementing online group activities successfully is impossible for only one lecturer. For this reason, facilitators were used to assist in implementing and monitoring online CL tasks. As a result of the shared responsibility of facilitation between the lecturer and various facilitators, the following research question came up for this study: What lessons can we learn from facilitators in establishing a teaching presence in a cooperative BL environment? In this section, we highlight the most important lessons that we have learnt from the facilitators regarding the establishment of a teaching presence in a cooperative BL environment.

## Cooperative learning

Regarding CL, from the participants' discussion, the group selection and allocation still appear to be problematic. We are of the opinion that because of the immense amount of administrative issues and the number of student queries involved with large classes, students should select their own groups. We do, however, suggest a follow-up comparative study exploring the use of self-selected groups versus heterogeneous grouping in this specific context to investigate which might be most effective.

The marks allocated to the role evaluation were 30% of the total marks allocated to the task. The intention of incorporating role division in the task was to promote positive interdependence and each member's higher feeling of individual accountability. However, the facilitators were concerned that this placed unnecessary pressure on students to fulfil their roles and shifted the focus away from the real purpose of the task. To alleviate this tension experienced by students, one could consider continuous peer-assessment in the future, where students would evaluate each other's contributions, rather than the facilitator doing the role evaluation. We also recommend that the remaining 70%, which was allocated to the final product, could be divided for both individual's contributions and group effort.

The facilitators recognised that three of the five elements were present in the course and functioned well. The two elements that were not successfully executed were group processing and promotive interaction. The facilitators made suggestions as to how the group processing could be enhanced in the future. They suggested that face-to-face reflection sessions might improve the group processing. Furthermore, we suggest that a more formal reflection schedule could assist the students to reflect more spontaneously. With regard to promotive interaction, we suggest that some of the face-to-face contact sessions could be used for brainstorming, planning and discussing the division of responsibilities.

## The use of technology

The facilitators reported that overall the technology was not a major barrier to the successful functioning of an online course. Students were familiar with LMS, but did initially find Google Docs difficult to work with. They did, however, overcome these issues with time. Facilitators suggested that in addition to the training videos that students were given, a more extensive technology training session could be made available for those who felt the need for this.

## Self-directed learning

Facilitators reported that various facets of SDL were promoted in the online CL task. Self-directed learning skills such as goal setting, planning and taking responsibility for their own learning were evident. However, because this is a comprehensive task that extends across the whole semester, we recommend that the task be subdivided to ease the monitoring of a large group. This should not replace the students’ own goal setting and planning but provide guidance and direction.

The facilitators offered their opinions about the relevance and significance of this course for the students as future educators. They reported that in their opinion it was a very good project and by exposing students to the use of technology, it would equip them for their role as future teachers. The SDL and CL environments provide students the opportunity to exercise skills such as teamwork, communication and lifelong learning, which are essential for 21st-century teachers.

## The role of the facilitator in relation to establishing a teaching presence

The facilitators' reflections are discussed under two main heads, namely the categories of teaching presence indicators as suggested by Garrison et al. (1999), and the aspects, which Garrison (2015) suggests, are important for facilitators in establishing a teaching presence. The first indicator, *instructional management*, was largely dealt with by the lecturer; however, the facilitators did attend to numerous administrative queries of the students. Concerning *building understanding*, the facilitators were successful in establishing and maintaining a learner-centred approach in the online environment. *Direct instruction* was maintained by the facilitators. They felt well-equipped to deal with subject-related queries. This applied to their facilitation of the subject content as well as the assessment of students' roles and their final task. This could be because they all had a teacher education background and qualification, and, wherever possible, were allocated groups within their field of specialisation and received formal facilitator training from the lecturer prior to the start of the online CL task.

Concerning the aspects that Garrison (2015) pointed out as important for facilitators in establishing a teaching presence, the facilitators also appeared to be able to address all of these aspects. They took their role as facilitator seriously and made sure that students felt comfortable in approaching them. They were able to promote student engagement at various levels. The facilitators reported that they had varied amounts of contact with students. We, however, recommend that in the future, clearer guidelines be given to facilitators in which regular and consistent online consultation hours are prescribed, as suggested by Vaughan (2016).

The facilitators were able to guide students to achieve the learning outcomes collaboratively and timeously. The course design was based on the principles of CL, which encouraged cooperation. As mentioned above, the facilitators felt well-equipped in terms of both content and pedagogical knowledge. The facilitators were very accommodating towards students and if students preferred to communicate via WhatsApp, which was not an official communication platform, facilitators accommodated them. The literature points out that social communication tools, such as WhatsApp, have a great potential in higher education, particularly for both smaller groups (Gachago et al. 2015) and peer communication (Astarilla & Warman 2017). The final aspect of establishing a safe and comfortable social environment was also successfully fulfilled by the facilitators.

## Guidelines and recommendations

From the discussion above, we compiled a list of guidelines (see Table 4.2) that could assist lecturers, course designers and curriculum developers in planning and implementing effective facilitation of large groups.

## Conclusion

This study was performed in a course that had a large number of students, and had an effect on all aspects of a course structure – facilitation, assessment and communication. Literature suggests that CL groups should be smaller, communication with students should be more frequent, and assessment feedback should be

**TABLE 4.2:** Guidelines for planning and implementing effective facilitation of large groups.

| **Theme** | | **Guidelines** |
|---|---|---|
| CL | Group structure | • The self-selection of groups is recommended to ease administration of large classes for facilitators. |
| | Student roles | • The role and responsibility of each group member must be clearly defined for facilitators to evaluate students.<br>• Allocate a percentage of the final mark to students' fulfilment of their roles. |
| | Assessment | • Make use of continuous student peer-assessment to assist facilitators in evaluating group members' contributions.<br>• The mark allocation towards the final product should be subdivided into a mark for the individual's contribution and a mark for the group contribution as a whole. |
| | The five elements of CL | • Facilitators should constantly be aware of and encourage the incorporation of the five elements of CL in the task. |
| The use of technology | Various technologies | • As far as possible, use technology that students and facilitators are familiar with.<br>• If new or unfamiliar technologies are used, sufficient support and training should be offered to facilitators as well as students.<br>• Facilitators should be equipped to support students' technology challenges. |
| SDL | SDL skills | • Facilitators should provide guidance and direction with regard to taking responsibility for their own learning e.g. planning, goal-settings and finding their own resources.<br>• Facilitators should encourage students to exercise 21st-century skills, e.g. working in teams, communication and lifelong learning. |
| Role of a facilitator | Teaching presence indicators | • Facilitators should be qualified to deal with the subject content. |
| | Aspects to consider when establishing a teaching presence | • Lecturers should provide clear guidelines with regard to the frequency and style of communication that facilitators should have with students.<br>• When using social communication platforms, strict ground rules should be put in place.<br>• For large groups, facilitators should communicate more frequently with group leaders than with each individual student.<br>• In a BL environment, facilitators should create opportunity for face-to-face support.<br>• Facilitators should be trained to deal with various aspects in the CL online environment, e.g. CL, SDL, subject content, technology, communication etc. |

CL, cooperative learning; SDL, self-directed learning; BL, blended learning.

continuous and more thorough. However, this could not always be possible with a facilitator–student ratio of 1:100+. Therefore, institutions have to be aware that in order to effectively implement BL environments, sufficient funding for online facilitators should be made available.

The lesson that we have thus learnt is that facilitators have the potential to assist in supporting large groups in cooperative BL environments, provided that they are sufficiently trained and equipped to support students. However, the facilitators should understand their role in promoting students' SDL and therefore the intensive training that focuses on the facilitation skills, the facilitator's role to enhance SDL, and the quality and quantity of feedback exercised. In large groups, the lecturer is not able to support all students successfully in a cooperative BL environment. We, therefore, conclude that the use of facilitators in supporting students in this environment definitely proved more effective than having the lecturer take full responsibility in establishing a teaching presence.

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Chapter 5

# Puzzle video games and the benefits for critical thinking: Developing skills and dispositions towards self-directed learning

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## Abstract

This chapter reports on research that investigates the potential benefits of a 13-week Puzzle Video Game-Cognitive Enrichment Programme (PVG-CEP) for the development of critical thinking among first-year BEd students at the North-West University (NWU). Critical thinking skills and dispositions are regarded as important cornerstones of SDL. Through the problem-solving activities found within the PVG-CEP, it was believed that critical thinking skills and dispositions could be developed that would lead to greater SDL. The research involved eight students who were conveniently sampled, and randomly assigned to an experimental (*N* = 4) and control (*N* = 4) group. Only the experimental group took part in the intervention. Quantitative test data were collected by using the Watson-Glaser Critical Thinking Appraisal (W-GCTA) test before and after the PVG-CEP. Qualitative, descriptive observation data were collected during the implementation of the PVG-CEP intervention. After the intervention, semi-structured face-to-face interviews were used to gauge the experiences of the participants of the experimental group by using the Portal puzzle video game. The initial findings revealed the latent and differential potential of the PVG-CEP for developing some of the critical thinking skills, dispositions and standards for reasoning on which the research focused.


**Keywords:** Puzzle video games; Portal; Critical thinking; Critical thinking dispositions; Standards for reasoning; Problem solving; Self-directed learning; BEd students.

## Introduction

The development of critical thinking has been considered as a crucial outcome and ideal of education ever since the early days of Plato, Socrates and Aristotle. Innovators in the field such as Beyer (1983), Dewey (1933), Ennis (1985) and Paul (1988) have provided definitions of critical thinking, which in essence highlight the strong element of thinking that is evaluative in nature. Critical thinking has also been linked to values such as freedom and autonomy (Winch 2006) and is regarded as a cornerstone for democratic citizenship and economic productivity (Arum & Roksa 2011), as well as a crucial skill for coping with challenges in the 21st century (Halpern 2014).

At the higher education level, the demands for students to solve problems through critical reasoning and argue about topics in an academic context are crucial (Barnett 2015; Bowell 2017; Erikson & Erikson 2018; Fahim & Shakouri 2012; Grosser & Nel 2013). Linked to the aforementioned, Barnett (2015), Bowell (2017), Erikson and Erikson (2018), Raidal and Volet (2008) and Van Woezik, Reuzel and Koksma (2019) argue that the purpose of higher education involves, among others, the following:

- To prepare students for future employment.
- To provide opportunities for personal development.
- To prepare graduates to become involved citizens in a democratic society. To start a lifelong, SDL journey to support students' development as adaptive, reflective practitioners. Essentially, this will mean that students take the initiative to define learning goals, the tasks to be met, the recognition of learning outlets and methods, and the evaluation of learning outcomes (Obied & Gad 2017).

To face the above-mentioned challenges, higher education needs suitable teaching and learning methods that encapsulate traces of intellectual development and student empowerment to strengthen SDL through the development of critical thinking (Dunne 2015; Erikson & Erikson 2018). Critical thinking could therefore be viewed as a curricular outcome that plays a role in SDL (Bailey 2016; Obied & Gad 2017). The link between critical thinking and SDL is made explicit by Obied and Gad (2017) who assert that critical thinking involves a compound process of applying skills to analyse, interpret and evaluate information to make a purposeful, self-regulatory judgement or decision. Dispositions and standards for reasoning are applied to enhance the effectiveness of the critical thinking process. In view of the close connection between SDL and critical thinking, the research reported in this chapter foregrounded the development of critical thinking with the aim to also strengthen the development of SDL.

In particular, for teacher education, the enhancement of critical thinking is important. Grosser and Nel (2013) assert that the development of critical thinking augurs well with the set of critical, generic, exit-level outcomes of the teacher-education programme at the university that took part in the research, and these are valued at a higher education level, namely:

- to solve problems
- to expand on the claim and to establish its consequences
- to grasp, interpret and test points and viewpoints
- to endorse general statements with info.

Consider the key concept of the research. Bearing in mind the importance of critical thinking for developing students who are self-directed at higher education in mind, it goes without saying that teachers are the key role players in ensuring that students at school become good critical thinkers (Warburton 2006; Williams 2005). The improvement of critical thinking skills and SDL has been on the agenda of South African education since 1997 (Department of Basic Education 2011; Department of Education 1997, 2002; Du Toit-Brits & Van Zyl 2017). According to the Curriculum and Assessment Policy Statement (CAPS) objectives (Department of Basic Education 2011:11), students should be capable of:

- finding and addressing challenges and taking choices through logical and innovative thinking
- functioning together as individuals and with others as leaders of a group
- organising and controlling oneself and their actions professionally and effectively
- collecting, analysing, organising and critically evaluating information
- interacting efficiently by using visual, verbal and/or linguistic capabilities in a number of modes

- using research and technology effectively by showing vital accountability for the atmosphere and the safety of others
- illustrating comprehension of the universe as a collection of connected processes by acknowledging that there are no conditions for problem solving that exist in isolation.

Although not explicitly stated in the CAPS, the authors argue that to execute the aforementioned thinking processes that underpin the curriculum objectives effectively, dispositions such as accuracy, persistence, perseverance, open-mindedness and self-confidence in reasoning are also required. In addition, the execution of all thinking should adhere to universal standards for reasoning, namely logic, clarity, breadth, depth, significance and clarity.

It is reasonable to assume that teachers first have to be effective at applying critical thinking themselves, before they can teach and develop critical thinking among students. Internationally (Akyüz & Samsa 2009; Allamnakrah 2013; Arum & Roksa 2011; As'ari, Mahmudi & Nuerlaelah 2017; Bakir 2015; Hashim 2010; Heiltjes et al. 2014; Innabi & ElSheikh 2007; King & Kitchener 2002; Osana & Seymour 2004; Qing, Jing & Yan 2010; Turan 2016; Umar Mahmudi & Nuerlaelah 2017; Bakir 2015; Hashim 2010; Heiltjes et al. 2014; Innabi & ElSheikh 2007; King & Ahmad 2010; Zascavage 2010) and nationally (Grosser & Lombard 2008; Lombard & Grosser 2004, 2008), evidence has established the vulnerable essence of critical thinking capabilities and the ability of pre-service instructors. Keeping in mind the connection between analytical thinking and SDL, the results may also suggest that SDL skills are in need of improvement.

An evaluation on critical thinking practices in higher education in nine European countries between 2000 and 2017 revealed that self-study, dialogue, mentoring, peer-assessment, experiments, interview, reflective diaries and reflective essay analysis are frequently used as interventions to enhance critical thinking. Moreover, PBL, enquiry and argumentation, as well as argumentation in e-leaning, are the teaching methods and strategies that appear to be favoured for the improvement of critical thinking (Dumitru et al. 2018). None of the mentioned studies, however, explicitly document the merits of puzzle video games for strengthening SDL through the development of critical thinking. Only a few studies could be identified that established a correlation between PBL, critical thinking and SDL in the field of nursing (Shahin & Tork 2013; Yew & Goh 2016).

Although a number of international research reports highlight the success of video games for cognitive stimulation (All, Nuñez-Casellar & Van Looy 2016; Bavelier et al. 2012, 2018; De Araujo et al. 2015; Granic, Lobel & Engels 2014; Hwang, Chiu & Chen 2015; Hung et al. 2012; Kadam, Sahasrabudhe & Iyer 2012; Lin & Chen 2016; Smith & Middleton 2003; Wouters & Van Oosterndorp 2017), Bhalla (2013) points out that nationally research in this regard is limited. No national or international studies that explored the use of video games for supporting the strengthening of SDL through the development of critical thinking in the field of teacher education could be identified, and therefore the identified gap provided something worthwhile and novel to explore.

The research reported in this chapter could therefore be of significance for all educationists involved in teaching and learning at primary and secondary school, as well as tertiary education levels, who are grappling with ways to develop critical thinking that could strengthen SDL.

On the basis of the discussion alluded to above, the authors intend to articulate the key purpose of this study as: to illuminate the potential benefits of the Puzzle Video Game-Cognitive Enrichment Programme (PVG-CEP) for developing critical thinking that could strengthen SDL among first-year BEd students, thus offering a novel and practical perspective to a field of study where practical guidance is often limited.

## ■ Problem statement

Critical thinking plays an important role in learning and coping with 21st-century challenges and uncertainties (Halpern 2014), is an important objective to be achieved according to the CAPS curriculum, and could be regarded as an important outcome at higher education level to strengthen lifelong SDL. Escalating evidence points to the reality that higher education students do not improve the critical thinking skills that should empower them to become self-directed students, which among others involve reasoning, argumentation and problem solving (Arum & Roksa 2011; Bok 2006; Pascarella et al. 2011). The consequence is an urgency to reform curricula and to embrace new educational philosophies and approaches to teaching (Van Wyk 2017).

With the aforementioned discussion in mind, the primary research question that directed the main aim of the research reported in this chapter was: how sophisticated are first-year BEd students in their application of critical thinking that could strengthen SDL, and based on the findings, how can a puzzle video game support the development of critical thinking that would strengthen SDL among first-year BEd students at a university? Answers to the questions would provide a novel and practical perspective to developing critical thinking that could strengthen SDL by making use of a puzzle video game.

The chapter subsequently focusses on the conceptual and theoretical framework adopted in the research.

# Conceptual and theoretical framework

## Theoretical framework

In the context of the research, a number of theories that encompass the broader relationships between strengthening SDL through the development of critical thinking, and ways to develop critical thinking, guided the execution of the research.

Cognitivism underpinned the development of critical thinking during active involvement in puzzle gameplay, as it postulates that during learning students should actively participate in acquiring, manipulating and retrieving information (Knowles, Holton & Swanson 2014; Merrill 2009; Reigeluth 2013).

Constructivism focusses on students building knowledge and meaning themselves, scaffolding concepts and ideas and making connections (Bächtold 2013; Berk 2012; Piaget 2013). This theory supports the strengthening of SDL by developing critical thinking and was adopted in the intervention programme, as participants were expected to construct their own knowledge to proceed in solving the puzzle problems.

Transformative learning theory helps people to shift their frames of reference by objectively focusing on their perceptions and values, and actively designing and executing strategies that can contribute to different forms of understanding and talking regarding their lives (Bunt 2012; Dirkx, Mezirow & Cranton 2006; Mezirow 1997). Participants had to reflect on their assumptions when solving the puzzle video game problems and devise new plans to solve problems if current assumptions to solving problems proved to be invalid.

Experiential learning theory holds the belief that learning comes from experiencing different situations and allowing students to actively explore different settings aside from the classroom (Kolb 2014; Svingby & Nilson 2011). This theory was fundamental to this research as the participants used their experiences of the puzzle video game to solve puzzle problems independently.

The research was built on the premise of structural cognitive modifiability theory, which postulates that fragile or deficient thinking skills and processes, including critical thinking skills, dispositions and standards for reasoning, can be reversed (Feuerstein, Feuerstein & Falik 2010). By means of mediated learning, the learning experiences during the puzzle video game intervention were intentionally structured and guided (Feuerstein 1990; Feuerstein et al. 2010) to enable students to autonomously acquire the desired skills, dispositions and standards for reasoning. In support of tangential learning, the research was built on the premise that learning will occur if it is presented in an interesting and enjoyable context, for example, using an entertaining video game as in the context of the research (Armstrong 2004; Leland 2016).

Finally, transfer of learning theory underpinned the implementation of the PVG-CEP intervention, as the authors hoped that the skills and behaviours that the participants possibly learned and developed in the puzzle video game context would be transferred to the Watson-Glaser Critical Thinking Appraisal (W-GCTA) test context (Bransford et al. 2000, Perkins & Salomon 1992; Schwartz, Bransford & Sears 2005). This process is known as transfer and refers to the application of skills to solve novel problems presented in a different context (Perkins & Salomon 1992). This argument also applied to the context of the W-GCTA test that was used for data collection, as it was hoped that the participants would transfer and apply the critical thinking skills they possibly learned and developed tangentially through the PVG-CEP to a new, non-tangential, written context.

## Conceptual framework

The conceptual framework comprises the variables that were explored in the research, and their relationships, thus being the mould in which the data were packaged (Regoniel 2010), namely critical thinking (skills, dispositions and standards for reasoning), SDL and the influence of puzzle video games on the development of critical thinking. In the context of the research, the relationship between the concepts implied that the strengthening of SDL through the development of critical thinking was promoted by using a puzzle video game, Portal, that incorporated the use of the GROW (Goal, Reality, Obstacles, Way forward) problem-solving model (Gorrell 2013).

According to some of the recent pioneers in the field, critical thinking comprises:

- cognitive skills (Facione 2009; Paul & Elder 2007; Watson & Glaser 2002a, 2002b)
- metacognitive skills (Facione 2009; Paul & Elder 2007)
- dispositions or intellectual traits (Facione 2009; Paul & Elder 2007)
- universal intellectual standards for reasoning (Paul & Elder 2007, 2008).

Facione (2009) mentions that cognitive skills such as interpretation (attachment of meaning to experiences), analysis (identifying relationships among statements, experiences opinions or information), evaluation (assessment of the credibility of statements, experiences, opinions and beliefs) and inference (drawing conclusions that reasonably flow from information) could be considered as core critical thinking skills.

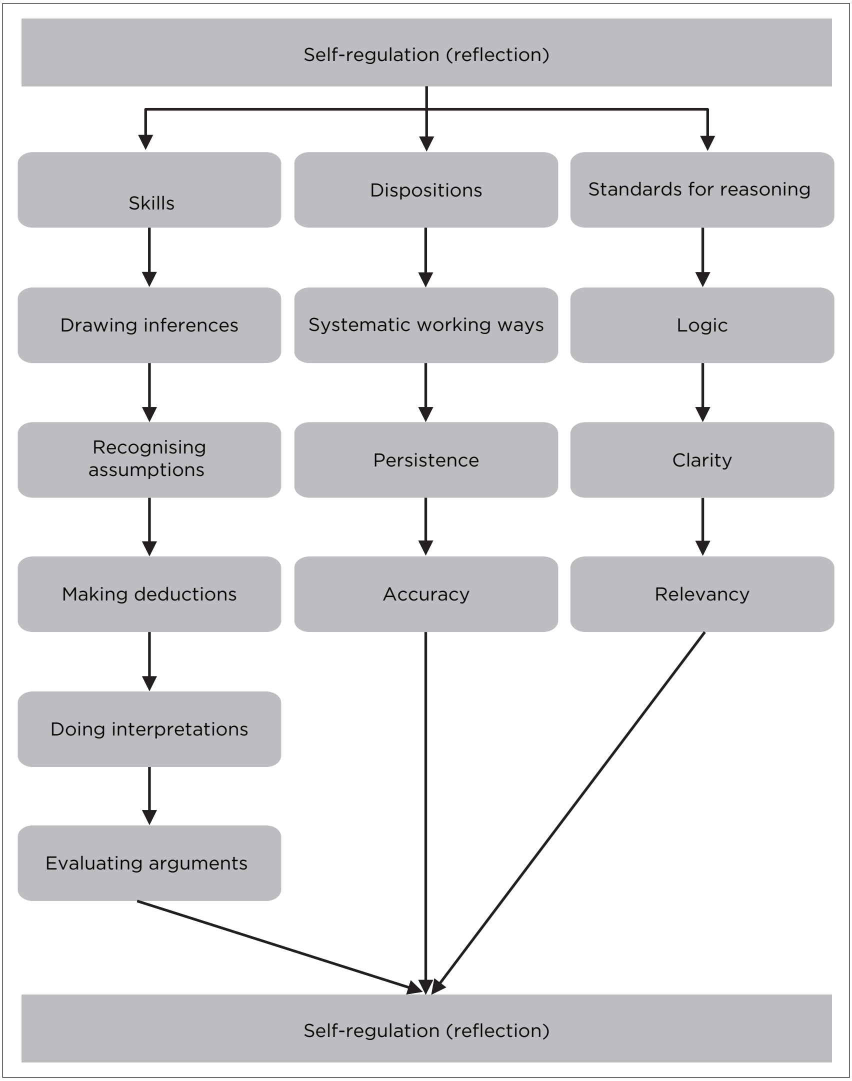
Aligned to the view of Facione (2009), the authors of the W-GCTA (Watson & Glaser 2002a, 2002b) that was used for data collection in the context of the research, the following cognitive and metacognitive skills play a role in critical thinking:

- Drawing inferences (cognitive skill): Students have to draw inferences from a series of factual statements.
- Recognising assumptions (cognitive skill): Students are required to identify unstated assumptions in a series of statements.
- Making deductions (cognitive skill): Students have to determine whether certain conclusions necessarily follow from information in given statements.
- Doing interpretations (cognitive skill): Evidence is weighted to decide if generalisations based on data are warranted.
- Evaluating arguments (cognitive skill): Students are required to distinguish between strong, relevant arguments and weak irrelevant arguments.

The metacognitive skills of explanation (presenting results of one's thinking in a coherent way) and self-regulation (skills involving reflection and self-reflexivity) play an important role in critical thinking (Facione 2009). Self-regulation and explanation are regarded as metacognitive skills because they involve reflective processes to clarify, rectify and justify one's own thoughts. Self-regulation is not explicitly measured by the W-GCTA and was also not explicitly measured during the research. However, the authors argue that evidence of shoddy thinking might point to being ineffective in self-regulation.

Dispositions or intellectual traits can be defined as attitudes or habits of mind, such as intellectual curiosity or inquisitiveness, scepticism or seeking the truth, being open minded, analytical, systematic and judicious, having self-confidence in reasoning (Facione 2009; Paul & Elder 2008). In addition, the habits of being accurate, persistent, analytic, anticipating both the good and the bad potential consequences of a situation and striving to approach problems in a systematic way are essential dispositions for critical thinking (Facione 2009). Intellectual habits that need to be well developed for the effective execution of critical thinking also include intellectual integrity, to remain true to one's own thinking and to admit inconsistencies in one's own thoughts and actions. Intellectual courage is important to be conscious of the need to face, address, and investigate ideas or beliefs towards which one might have fairly strong emotions (Facione 2009; Paul & Elder 2008).

Good critical thinking adheres to a number of intellectual standards for reasoning (Paul & Elder 2008). Such principles would be learned and presented specifically to graduates. The aim is for these principles to be instilled in students' thought, to be part of their inner speech and to lead them to better reasoning (Anon 2020b; Paul & Elder 2008). Standards for reasoning also involve clarity (expressing in another way), accuracy (checking whether something is true), precision (accurate detail), relevance (determining whether information is connected), significance (importance of information), breadth (obtaining insight and depth) and logic (ordering thoughts) (Paul & Elder 2008:8). Although the chapter did not aim to purposively report on the development of the intellectual standards for reasoning, they were included in the conceptualisation of critical thinking and regarded as part of the research, as they are required to ensure the quality of the application of the skills and dispositions (Paul & Elder 2008).




*Source*: Bunt (2019:50).

**FIGURE 5.1:** The conceptualisation of critical thinking in the context of the research.

Figure 5.1 shows the summary of the authors' conceptualisation of critical thinking in the context of the research.

Figure 5.1 shows that in the context of the research, critical thinking comprised the integrated application of three different elements to be effective at solving problems during the PVG-CEP. Developing critical thinking therefore does not only involve a process of cognitive actions. Dispositions and emotions, as well as standards for reasoning, are intrinsic to being critical (Burbules 2016; Sibbett 2016). Firstly, various critical thinking skills, as conceptualised by Watson and Glaser (2002a), namely cognitive skills such as making inferences, recognising assumptions, making deductions and evaluating arguments, and doing interpretations, as well as the meta-cognitive skill that involves reflective and self-regulated thinking (Facione 2009), need to be applied throughout the critical thinking process. The second element involves the application of critical thinking dispositions, such as working systematically with persistence and accuracy (Facione 2000), and the third element entails adhering to standards for reasoning, which include logic, clarity and relevancy (Paul & Elder 2006). During problem solving as part of the PVG-CEP intervention, the students had to deal with a number of elements of reasoning, such as identifying the purpose of their actions, posing questions to solve problems, recognising assumptions that could obstruct the successful solving of problems, searching for evidence to solve problems and making inferences about their proposed ways to solve problems. Guiding the application of all the skills, dispositions and standards for reasoning is the meta-cognitive skill of self-regulation that plays an important role in SDL and involves continuous reflection about and improving the quality and correctness of the application of the cognitive skills, dispositions and standards for reasoning. The development of good critical thinking skills implies that the three mentioned elements (skills, dispositions, standards for reasoning) have to be developed in unison. For example, reasonable conclusions will not flow from given information, if inferences that are made are not accurate and logic.

The number of dispositions and standards for reasoning that were addressed in the research were limited, to include those that were regarded as most relevant to the implementation of the PVG-CEP, and to enable more reliable observations during the implementation of the intervention. The conceptualisation was applied throughout the research, and the application of all elements were nurtured as part of the PVG-CEP intervention.

Critical thinking plays an important role in SDL. According to research conducted by Bailey (2016), critical thinking skills foster SDL skills. When the development of critical thinking improves, SDL improves, and when critical thinking declines, SDL also declines (Bailey 2016). Self-directed learning is briefly defined as a process in which students make the effort to assess their academic needs, establish academic goals, define learning opportunities, select and execute learning approaches, and analyse learning outcomes (Anon 2020b; Knowles 1975). A careful analysis of the definition indicates that critical thinking skills such as analysis, evaluation making inferences, explanation, interpretation and self-regulation lie at the core of SDL. Moreover, the characteristics of an SDL student according to Barrett (2014) and Guglielmino (2013) align well with a number of critical thinking dispositions identified by Costa and Kallick (2009), Facione (2009) and Paul and Elder (2008), namely perseverance, goal orientation, self-motivation, creativity, resilience, responsibility, curiosity, inquisitiveness, questioning, organised and possessing good communication skills.

Since the early 1960s, a wide range of perspectives characterised SDL, namely a 'critical analysis of the learning situation' (Hammond & Collins 1991:13), 'self-teaching' – autonomous planning and directing the course of learning (Brookfield 1993:229), 'self-initiated learning' – personal autonomy over the planning and management of learning (Caffarella 1993:25) and 'independent learning' – taking ownership of responsiveness to learning (Garrison 1997:18; Long 1998:25). In addition, terminology such as ‘autonomous learning’, ‘independent learning’, ‘self-direction in learning’ and ‘self-plan learning’ (Chang 2012:53) add to the challenging process of describing SDL.

Du Toit-Brits (2018:54, 55) adds that SDL needs to be ‘transformative’ and ‘holistic’ in nature. Students need to reflect on their thoughts and feelings during learning experiences and give meaning to learning experiences that concurrently influence their lives, and lead to their transformation of becoming ‘self-directed, lifelong, goal-oriented students’.

According to the authors, the development of critical thinking skills, dispositions and standards for reasoning contributes to strengthening SDL. The development of critical thinking skills equips students with the competencies to become independent, self-regulated, reflective and engaged individuals, as well as with the dispositions to display, among others, persistence, open mindedness, curiosity, self-confidence in reasoning and accountability as a self-directed student (Bunt 2019). In this regard, Obied and Gad (2017) argue that successful SDL depends on strong independence, having curiosity and self-confidence in one’s own abilities to organise and plan learning tasks to solve problems.

Problem-based learning and problem solving are regarded as important for nurturing the development of critical thinking and SDL (Choi, Lindquist & Song 2014; Guglielmino 2013). According to Fantin (2014) and Obied and Gad (2017), problem solving consists of employing conventional or ad hoc techniques, in an organised way, to pursue answers to challenges. Problems can also be categorised as ‘ill-defined’ and ‘well-defined’ (Buchner 1995:17). Ill-defined challenges are ones that do not have specific objectives, solutions or planned goals (Bunt 2012). According to Schacter, Gilbert and Wegner (2000:376) ‘well-defined problems have specific goals, clearly defined solution paths, and clear expected solutions’.

Well-developed critical thinking dispositions are required when solving problems (Anderson 2010; Costa 2009). When solving problems, it is also important to work according to a systematic strategy that requires the critical thinking skill of reflection, which also plays an important role in SDL. Reflection during problem solving refers to managing the problem-solving process by self-regulating the planning, monitoring and evaluating of learning while it is taking place and constantly adjusting and changing learning strategies to enhance the effectiveness of the learning (Ertmer & Newby 1996).

The problem-solving scenarios presented within the puzzle video game Portal, which were used in the context of the research, could be defined as a combination of ill-defined and well-defined problems. Some of the scenarios are very simple and the goals can be found easily. Others are more complex, requiring one to seek out the goal while at the same time trying out novel methods to solve the problem.

To be effective at problem solving, one needs to consider a few points (Paul & Elder 2006), the first of which is to re-articulate your goals, purposes and needs regularly, thus being able to self-direct the problem-solving activity. Self-directing the problem-solving activity implies that problems should be taken up one by one and should be stated as clearly as possible. One should be able to distinguish whether a problem is controllable or uncontrollable. One needs to analyse and interpret information carefully, drawing from it the most reasonable inferences. Actions need to be organised into short- and long-term ones. Sometimes a strategic approach works the best. Once action is taken, one should be sure to monitor the implications of the action, as well as evaluate the outcome of the action (Paul & Elder 2006).

In the case of the research, each participant was involved in the PVG-CEP intervention programme independent of one another and therefore played the game on their own, allowing for independent instruction. Independent instruction supports the development of inferential thinking, deductive reasoning skills and the ability to evaluate arguments that stand central to the development of critical thinking. It encourages students to strive for more than superficial learning of information (Kuhlthau, Maniotes & Caspari 2007). A specific problem-solving strategy was employed within this research that supports independent learning, namely the GROW model (Table 5.1). The GROW model (or process) is a simple method for goal setting and problem solving (Gorell 2013) and a means to structure or plan the problem-solving situation that formed part of the PVG-CEP intervention.

To develop critical thinking and strengthen SDL, puzzle video games were employed during the research. According to Kloppers and Grosser (2014), as well as Pho and Dinscore (2015), game-based learning is becoming progressively common in higher education as a means to involve students in the learning process. Besides, research conducted by Rashid and Asghar (2016) found that SDL is positively related with technology use and engagement.

Puzzle video games offer great potential to facilitate formal and beyond the classroom learning engagement, as well as

**TABLE 5.1:** The GROW problem-solving model.

| Letter | Word | Model |
|---|---|---|
| G | Goal | The goal is the end point, where the students want to be. |
| R | Reality | The current reality is where the student is now. What are the issues, the challenges, how far are they away from their goal? |
| O | Obstacles | There will be obstacles stopping the student getting from where they are now to where they want to go. |
| | Options | Once obstacles have been identified, the student needs to find ways of dealing with them if they are to make progress. These are the options they must find. |
| W | Way Forward | The options then need to be converted into action steps, which will take the student to their goal. These action steps form the way forward (Passmore 2015). |

*Source*: Gorell (2013:34–37).

encourage problem solving (Arnab et al. 2012). Video games support learner-centred experiences, where critical thinking skills and dispositions as well as skills for SDL can be nurtured, namely active construction rather than passive reception of knowledge, opportunities to solve problems, make decisions, inquire, collaborate and be creative (Arnab et al. 2012). Students have the opportunity to communicate and reason and, in the process, develop confidence in their reasoning, as well as seek the truth by engaging in probing and searching for the best possible information or solutions to problems. According to the authors, all of the aforementioned activities that the students require to analyse, interpret and communicate information need to be characterised by the following standards for reasoning, namely clarity, accuracy, precision, relevancy, breadth, significance and logic. Important critical thinking strategies that often play a role in SDL, such as open-mindedness and acceptance of novel ideas, optimism, desire for proof and reasoning, awareness of alternatives, perseverance, a propensity to focus on studying, imaginative use of creativity and interest, may be nurtured and strengthened through playing video games (Anon 2020a). In addition, distinguishing between urgent and unimportant facts as well as reflecting on decisions made will play an important role when engaged in video games.

Some recent research have found that video games, whether violent or not, will help children build mental and social capabilities that sustain their academic accomplishments (All et al. 2016; Baniqued et al. 2013; Bavelier et al. 2018). Such results have helped teachers around the globe understand the multiple advantages of games to incorporate interactive video game programming in their curricula (Bunt 2012). The authors did not find any benefits specifically mentioned in relation to the development of critical thinking and SDL. It could therefore be argued that the present research aimed to address a gap in the field of research.

The following section discusses the PVG-CEP intervention that was used in the research to develop critical thinking to consequently strengthen SDL.

## The Puzzle Video Game-Cognitive Enrichment Programme intervention

The four participants in the experimental group received individual exposure to the PVG-CEP, once a week for two hours across 13 weeks. A number of data collection instruments were employed to establish the merits of the PVG-CEP for developing critical thinking skills, dispositions and standards for reasoning. Because of time constraints, the participants in the control group did not receive the PVG-CEP intervention. The intensive nature of the intervention required that individual attention was given to participants and could therefore not be implemented in a group.

The intervention programme made use of the video games Portal 1 and Portal 2. Portal 2 is far more advanced and a longer game than Portal 1, adding new elements that make it more challenging. In Portal, the player controls one of the characters in the game, Chell, who is challenged to find a way out of a number of chambers by completing puzzles in an Aperture Science Enrichment Centre, using the Aperture Science Handheld Portal Device, or portal gun, under the watchful supervision of GLaDOS, a computer. Each puzzle includes utilising the Aperture Science Handheld Portal Device – the portal gun – that generates a human-sized wormhole-like link between almost any two flat surfaces (Larstuk 2011). Players must overcome spatial puzzles and obstacles by creating portals for manoeuvring artefacts themselves across space (Mittell 2012). This requires complicated flinging movements to be used to cross large gaps or execute certain stunts to access the exit for each test chamber. A variety of external features, such as lasers, light bridges, tractor enclosures and cannons, are required to help or obstruct the aim of the player to enter the escape (Bunt 2012).

To enable the participants to feel comfortable in taking part in the PVG-CEP, they had to be prepared by the authors. For this purpose, game instruction played an important role. Using mechanics is the meat of the puzzles in the Portal series. Numerous machines, containers, cylinders, gels and threats are strategically positioned around the research chambers in this respect.

The mechanics of both Portal 1 and Portal 2 were discussed in the first week of the intervention programme, in which the authors demonstrated the first level of the game and outlined the various mechanics and how they function within the game. This acquainted the students with how to play the game and to master the basic skills early on. Throughout the intervention, many opportunities were provided via the game self, where participants were first introduced to certain mechanics to become acquainted with their use, before engaging in real problem-solving gameplay.

An important consideration for employing the Portal puzzle game in the research links to the fact that the gameplay reinforces a number of important teaching and learning principles identified by Schiller (2008), and Valve Software (2007) that the authors regarded as beneficial for the development of critical thinking, and subsequently strengthening SDL.

Portal supports the following teaching and learning principles:

- Scaffolding: In support of constructivist teaching and learning principles, Portal comprises structured and discrete learning activities that scaffold (Kompf & Bond 2001; Moon 2004) the achievement of learning goals. In each new game level, the tutorial nature of the game and support are slowly removed and more complex challenges are presented. As the game progresses, support is taken away and players are free to make independent choices and practise skills in creative ways.

- An incremental, engaging and a challenging approach to learning: The game is not extremely difficult at the beginning levels, so that participants do not feel overwhelmed. As participants become more skilled, levels of complexity and difficulty increase gradually, so that participants can remain engaged and challenged, thus supporting tangential and experiential learning theory. Gradually, increasing difficulty provides more challenges, and opportunities for skills to be reinforced. Mediation of challenge is an important component of mediated learning, which played an important role in the implementation of the PVG-CEP.
- Enhancing focus by eliminating distractions: The game removes anything that might distract a player from acquiring a skill or concept. Removing distractions enables game players to quickly acquire skills and concepts that will reduce trial-and-error attempts in solving problems.
- Mandatory pausing: Pausing avoids rushing through the gameplay and not noticing important clues that assist in solving the puzzle game problems. In the game context, the pauses are referred to as gates that indicate that a player may not advance if certain conditions are not adhered to. According to the authors, mandatory pausing is beneficial for developing self-regulation skills to enhance the accuracy of behaviour and action.

Instruction on how to use the GROW problem-solving model was provided to all the participants during week 1. Each participant received a copy of the GROW problem-solving model (see Table 5.1) to utilise during gameplay to promote independent and self-directed planning and solving of the puzzle problems that formed part of the PVG-CEP intervention.

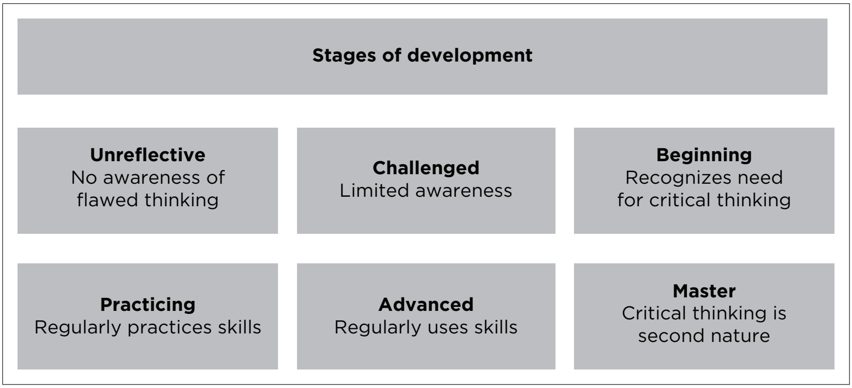
During Portal gameplay, the participants developed a number of critical thinking and SDL skills such as, asking questions, finding relevant information to solve problems, analysing information, thinking critically and creatively about information, reflecting about information and making thoughtful decisions, defining own learning goals, being self-engaged, and developing a sense of ownership and leadership of learning (Beach 2017; Du Toit-Brits 2018; Gibbons 2002; Van Woezik et al. 2019). The implementation of the PVG-CEP intervention was not aligned to achieving curriculum-related objectives. Participants were involved in non-formal and informal, self-directed, experiential learning by employing a puzzle video game to develop critical thinking.

# Empirical investigation

## Research methodology

Quasi experimental research within an embedded mixed method experimental research design (Creswell 2014) was utilised, to investigate the potential benefits of the PVG-CEP for the development of critical thinking of first-year BEd students (*N* = 4). For the quantitative research component, descriptive survey research was utilised (Leedy & Ormrod 2005, 2013), and for the qualitative component, multiple case studies that involved a comprehensive within-case analysis, as well as a cross-case analysis of the data (Merriam 2009), were used. In the context of this research, the case could be described as the eight first-year BEd students at the NWU who were included in the experimental and control groups (a group of individuals bounded in time and place).

The W-GCTA (UK version) was administered to collect quantitative data before and after the implementation of the PVG-CEP, about the application of the participants' critical thinking skills in five tests that each focused on a critical thinking skill, namely making inferences, identifying assumptions, making deductions, doing interpretations and evaluating information (Watson & Glaser 2002a). The authors could not identify any comprehensive standardised tests available in South Africa for measuring the interrelated application of critical thinking skills, dispositions and standards for reasoning. The test results out of




*Source*: Paul and Elder (2005:19).
**FIGURE 5.2:** Stages of critical thinking development.

16 for each individual test, as well as the test total out of 80, were interpreted as novice (unreflective, challenged) (0–4, 0–20), able (beginning) (5–6, 21–40), skilled (practising) (9–12, 41–60) and sophisticated (advanced/master) (13–16, 61–80). The classifying of the test results was based on the work in the field by Elder and Paul (2010) and Papp et al. (2014) who provide an indication of how critical thinking might develop and manifest across different stages, as shown in Figure 5.2.

Qualitative data were collected during the implementation of the PVG-CEP and comprised the use of observations supported by video recordings that were guided by a predetermined four-point rating scale (Cohen, Manion & Morrison 2007). The scale contained qualitative, descriptive criteria to make some judgement about the incidence, presence, quality and frequency of the participants' application of the critical thinking skills, dispositions and standards for reasoning that were observed during Portal gameplay. It was essential to establish growth, decay and retention of the critical thinking skills, dispositions and standards for reasoning on which the research focused. Four developmental levels (see Figure 5.3) suggested by Anderson (2012) were used for classifying observed growth qualitatively, namely, 1 – Novice, 2 – Able, 3 – Skilled and 4 – Sophisticated. These levels enabled the authors to capture continuous, accumulative information about the nature and quality of the participants' practical application of critical thinking, thus not just relying on a quantitative test outcome to make conclusions about the development of critical thinking.


*Source*: Bunt (2019:202); Visual adapted from Anderson (2012) and Costa (2009).

**FIGURE 5.3:** Qualitative observation descriptors.

In support of uniform observations, the four levels shown in Figure 5.3 guided the observations for the application of the critical thinking skills, dispositions and the standards for reasoning. The authors aligned the developmental levels used during the observations to the categories identified for classifying the W-GCTA test results to make final interpretations.

The video recordings were used to verify the correctness of the observations. To complement the observations, the authors also compiled anecdotal records for each participant across the 13-week intervention, related to the cognitive functioning of each participant (Boyd-Batstone 2004; Nieuwenhuis 2016a). During the intervention, participants were requested to analyse situations within the game and the authors evaluated their performance and their reasoning ability in terms of, for example, what assumptions and deductions they were making, and the strategies they employed to solve the problems. The authors ensured to understand and reveal the actions, words, expressions and thinking behaviours of the participants (McMillan & Schumacher 2006; Strydom 2002), which involved speaking with and asking questions of the participants. Anecdotal records captured the reactions and comments of the participants (Strydom 2002).

A trained co-observer also compiled observations independently of the authors and captured the game involvement of the participants on video. The video recordings were not used for data collection purposes, but merely to verify the observations made by the authors and co-observer to ensure an accurate account of a participant's involvement during the intervention, and to clarify any differences between the observations of the authors and co-observer.

During the observations, the authors became part of the research process by working with the participants. They became part of the situation by mediating the dynamics of the situation in an attempt to understand the development of critical thinking skills, dispositions and standards for reasoning of the participants (Cohen et al. 2007; Nieuwenhuis 2016b).

At the completion of the intervention, semi-structured interviews were conducted with the four selected student participants in the experimental group to understand their perspectives and thoughts on the development of critical thinking using the puzzle video game, Portal. The data were used to support the quantitative data and qualitative data collected through the W-GCTA and the observations.

## Participant selection

In the context of the research, the quantitative sampling entailed a nonprobability, convenient, purposive sample of eight first-year BEd students from the NWU on the Vaal Triangle Campus that formed part of an experimental group (*N* = 4) and a control group (*N* = 4). The eight participants were purposively selected, based on the results of the Toets vir Akademiese Geletterdheid (TAG)/ Test for Academic Literacy (TALL) that first-year students write to identify the extent of academic preparedness before they start their studies at a higher education institution (Van der Silk & Weideman 2008). The test does not exclusively assess the development of critical thinking, but it addresses a number of critical thinking skills such as making deductions, formulating definitions, identifying cause and effect relationships and distinguishing between main ideas and detail (Van der Silk & Weidman 2008), which are regarded as important for academic preparedness.

The TAG/TALL test results are reported as a percentage, and the selection of the eight students based on the following guidelines:

- two students with the highest scores in the percentage range 80–100 (category 1)
- two students with the highest scores in the percentage range 70–79 (category 2)

- two students with the highest scores in the percentage range 60–69 (category 3)
- two students with the highest scores in the percentage range 50–59 (category 4).

The research included participants who were perceived to be at different levels of academic preparedness, in the research, and the selected participants were allocated randomly to the experimental and control groups. The qualitative selection of participants for the interviews involved purposive criterion sampling, as only the four students in the experimental group were approached to take part in the interviews.

Table 5.2 shows the summary of the biographical characteristics of the participants who took part in the research.

## Ethical aspects

The research adhered to ethical criteria that guaranteed that no harm would be caused to participants, that participation in the research was voluntary and informed consent was sought before commencing with the research. The research was granted ethical clearance by the governing ethics committee of the NWU.

**TABLE 5.2:** Biographical characteristics of the participants.

| Group | Participant | Age | Gender | Ethnic group | TAG/TALL result |
|---|---|---|---|---|---|
| **Experimental** | 1 | 18 | Male student | African | 86% |
| | 2 | 18 | Female student | African | 76% |
| | 3 | 18 | Female student | African | 64% |
| | 4 | 18 | Male student | African | 56% |
| **Control** | 5 | 19 | Male student | Coloured | 82% |
| | 6 | 19 | Male student | African | 78% |
| | 7 | 18 | Female student | African | 65% |
| | 8 | 18 | Female student | African | 56% |

*Source*: Bunt (2019:190).
TAG/TALL, Toets vir Akademiese Geletterdheid/test for academic literacy.

## Quality criteria

The validity of the quantitative research design was ensured by adhering to criteria for internal, external, construct and statistical conclusion validity (McMillan & Schumacher 2006, 2014). In addition, the W-GCTA adhered to quality criteria that ensured face, content, criterion and construct validity (Leedy & Ormrod 2005, 2013). The qualitative research complied with criteria for transferability, credibility, dependability and confirmability (Lincoln & Guba 1985).

## Data analysis procedures

Descriptive statistical procedures and non-parametric inferential statistics (Ivankova, Creswell, & Plano Clark 2007; Pietersen & Maree 2007a) were used to make tentative conclusions about the merits of the PVG-CEP intervention. The Mann–Whitney U test was used to compare the pre- and post-test results of the experimental group, with the results of the control group, and the Wilcoxon signed-rank test was used to compare the differences between the pre- and post-test results within the experimental and control groups (Pietersen & Maree 2007b). Content analyses were performed to analyse the observation and interview data.

## Research results

Table 5.3 and Table 5.4 show a collective summary of the growth noticed in relation to the five critical thinking skills and the dispositions and standards for reasoning on which the research focused for all four participants in the experimental group.

According to Table 5.3 and Table 5.4, the intervention seemed to have had a differential influence on the development of the critical thinking skills and the dispositions and standards for reasoning of the participants. Of all five skills tested in the pre- and post-tests, making inferences apparently benefitted the

**TABLE 5.3:** Growth in critical thinking skills: Experimental group.

| Participant | Inference | Assumptions | Deduction | Interpretation | Arguments | Observations |
|---|---|---|---|---|---|---|
| 1 | beginning to practising | - | - | - | - | The observations showed growth for all skills: novice to skilled/sophisticated (inference, arguments), novice to sophisticated (assumptions, deductions, interpretations). |
| 2 | beginning to practising | beginning to practising | - | - | - | Observations showed growth only for inferences and evaluating arguments (novice-able). |
| 3 | - | - | - | - | - | Observations showed growth for all skills from novice to able (inferences) and novice to skilled (assumptions, deductions, interpretations, arguments). |
| 4 | unreflective (challenged) to practising | - | Unreflective (challenged) to beginning | beginning to practising | - | Observations showed growth for all skills from novice to able/skilled (inferences), novice/skilled to sophisticated (identifying assumptions), novice to skilled/ sophisticated (deductions), novice/able – skilled/ sophisticated (evaluating arguments) and novice to sophisticated (interpretations). |

*Source*: Bunt (2019:280).

**TABLE 5.4:** Improvement in dispositions and standards for reasoning: Experimental group.

| | Dispositions | | | Standards for reasoning | | |
|---|---|---|---|---|---|---|
| Participant | Systematic working ways | Persistence | Accuracy | Logic | Clarity | Relevancy |
| 1 | novice-sophisticated | able-sophisticated | novice-sophisticated | novice-sophisticated | able-skilled | novice-sophisticated |
| 2 | - | - | - | - | - | - |
| 3 | novice-skilled | novice-skilled | novice-skilled | novice-skilled | novice-able | novice-skilled |
| 4 | able-sophisticated | able-sophisticated | able-sophisticated | able-sophisticated | able-sophisticated | able/skilled-sophisticated |

*Source*: Bunt (2019:281).

most from the intervention in terms of growth. Participant 1 demonstrated improved growth in the application of inferential thinking. In addition, growth was observed for the application of all the dispositions and standards for reasoning. Participant 2 achieved growth in the application of making inferences and identifying assumptions. However, no growth was noted for any of the dispositions, or standards for reasoning. Participant 3 seemingly did not benefit from the intervention in relation to growth for the application of any of the critical thinking skills. Nevertheless, growth was indicated during the observations for all the dispositions and standards for reasoning. Of all the participants, participant 4 apparently benefitted the most from the intervention, as the application of three of the critical thinking skills, namely making inferences and deductions and doing interpretations, testifies to growth. Besides, growth was showcased for all the dispositions and standards for reasoning. One of the skills, namely evaluation of arguments revealed no growth among any of the participants. It could be argued that its application therefore possibly did not benefit from the intervention.

Table 5.5 shows the findings obtained for the participants in the control group.

**TABLE 5.5:** Improvement in critical thinking: Control group.

| Participant | Inference | Assumptions | Deduction | Interpretation | Arguments |
|---|---|---|---|---|---|
| 5 | beginning to practising | | | | |
| 6 | unreflective/ challenged to beginning | beginning to practising | | | |
| 7 | beginning to practising | unreflective/ challenged to practising | beginning to practising | | practising to advanced master |
| 8 | beginning to practising | | | | |

*Source*: Bunt (2019:292).

According to Table 5.5, of all five skills tested in the pre- and post-tests, inference saw the most improvement among all four participants in the control group. The growth noted for the critical thinking skills as shown in Table 5.5 could imply that the participants' normal academic programme provided some opportunity for developing and practising the critical thinking skills on which the research focused. Participant 7 seemed to have the best scores in the post-test, but his TAG/TALL test results actually revealed a modest score in relation to the skills to cope academically. This could be interpreted as displaying that during the course of the semester, during normal academic classes, this participant was seemingly able to acquire critical thinking skills and could therefore cope better once the post-test had been written.

Table 5.6 shows the comparison of the pre- and post-test results for the experimental group.

According to Table 5.6, no statistically significant differences occurred within the experimental group between the pre- and post-tests for any of the five skills on which the W-GCTA focused. Although higher means were obtained in the post-test for *inference, deduction* and the *test total*, the differences were not statistically significant, as $p > 0.05$ in all instances. The authors can therefore not conclude with certainty that the intervention contributed to the improvement noticed in the post-test results.

Table 5.7 depicts data to illustrate the statistical significant differences between the pre- and post-test results for the control group.

According to Table 5.7, no statistically significant differences occurred within the control group between the pre- and post-tests for any of the five skills on which the W-GCTA focused. Although higher means were obtained in the post-test in relation to making *inferences, recognising assumptions* as well as for the *test total,* the differences were not statistically significant, as $p > 0.05$ in all instances. It could be assumed that the normal

**TABLE 5.6:** Comparison of differences between pre- and post-test totals: Experimental group.

| Experimental Group | Group A | N | Mean | Median | Mean rank | | | Mean rank | | Sum of ranks | | Z | *p* | *r* | Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Neg. | Pos. | Ties | Neg. | Pos. | Neg. | Pos. | | | | |
| **Inference (16)** | **Post-test** | 4 | 9.3 | 9.5 | 0 | 4 | 0 | 0.00 | 2.50 | 0.00 | 10.00 | -1.841 | 0.066 | - | - |
| | **Pre-test** | 4 | 6 | 6.5 | | | | | | | | | | | |
| **Assumptions (16)** | **Post-test** | 4 | 10.3 | 10 | 3 | 1 | 0 | 2.50 | 2.50 | 7.50 | 2.50 | -0.921 | 0.357 | - | - |
| | **Pre-test** | 4 | 11.5 | 12.5 | | | | | | | | | | | |
| **Deduction (16)** | **Post-test** | 4 | 8.0 | 7.5 | 1 | 2 | 1 | 2.00 | 2.00 | 2.00 | 4.00 | -0.577 | 0.564 | - | - |
| | **Pre-test** | 4 | 7.5 | 8.5 | | | | | | | | | | | |
| **Interpretation (16)** | **Post-test** | 4 | 8.8 | 8.5 | 0 | 1 | 3 | 0.00 | 1.00 | 0.00 | 1.00 | -1.000 | 0.317 | - | - |
| | **Pre-test** | 4 | 8 | 7.5 | | | | | | | | | | | |
| **Arguments (16)** | **Post-test** | 4 | 8.3 | 7.5 | 2 | 1 | 1 | 2.50 | 1.00 | 5.00 | 1.00 | -1.069 | 0.285 | - | - |
| | **Pre-test** | 4 | 9.75 | 9.5 | | | | | | | | | | | |
| **Test total (80)** | **Total post-tests** | **4** | **44.7** | **43.5** | **0** | **4** | **0** | **0.00** | **2.50** | **0.00** | **10.00** | **-1.826** | **0.068** | **-** | **-** |
| | **Total pre-tests** | **4** | **42.75** | **42** | | | | | | | | | | | |

*Source*: Bunt (2019:296).
Significance: $p < 0.05$.

**TABLE 5.7:** Comparison of differences between pre- and post-test totals: Control group.

| Control Group | Group A | N | Mean | Median | Mean rank | | | Mean rank | | Sum of ranks | | Z | *p* | *r* | Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Neg. | Pos. | Ties | Neg. | Pos. | Neg. | Pos. | | | | |
| **Inference (16)** | **Post-test** | 4 | 8.75 | 9.5 | 0 | 4 | 0 | 0.00 | 2.50 | 0.00 | 10.00 | -1.841 | 0.066 | - | - |
| | **Pre-test** | 4 | 5.5 | 5.5 | | | | | | | | | | | |
| **Assumptions (16)** | **Post-test** | 4 | 11 | 11 | 2 | 2 | 0 | 1.50 | 3.50 | 3.00 | 7.00 | -0.736 | 0.461 | - | - |
| | **Pre-test** | 4 | 9 | 9.5 | | | | | | | | | | | |
| **Deduction (16)** | **Post-test** | 4 | 8 | 8 | 1 | 2 | 1 | 3.00 | 1.50 | 3.00 | 3.00 | 0.000 | 1.000 | - | - |
| | **Pre-test** | 4 | 8 | 8.5 | | | | | | | | | | | |
| **Interpretation (16)** | **Post-test** | 4 | 7.25 | 7 | 1 | 2 | 1 | 3.00 | 1.50 | 3.00 | 3.00 | 0.000 | 1.000 | - | - |
| | **Pre-test** | 4 | 7.5 | 7.5 | | | | | | | | | | | |
| **Arguments (16)** | **Post-test** | 4 | 9.25 | 8.5 | 2 | 1 | 1 | 2.00 | 2.00 | 4.00 | 2.00 | -0.535 | 0.593 | - | - |
| | **Pre-test** | 4 | 10.25 | 9.5 | | | | | | | | | | | |
| **Test total (80)** | **Total post-tests** | **4** | **44.25** | **41.5** | **0** | **4** | **0** | **0.00** | **2.50** | **- 0.00** | **10.00 -** | **-1.826** | **0.068** | **-** | **-** |
| | **Total pre-tests** | **4** | **40.25** | **40** | | | | | | | | | | | |

*Source*: Bunt (2019:301).
Significance: $p < 0.05$.

**TABLE 5.8:** Comparison: Pre-test results – Experimental and control group.

| Test | Group | N | Mean | Median | Mean rank | Sum of ranks | Mann–Whitney U | Z | Significance ($p$) | $r$ | Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Inference (16)** | **Pre-test experimental** | 4 | 6 | 6.5 | 5.00 | 20.00 | 6.000 | -0.599 | 0.549 | - | - |
| | **Pre-test control** | 4 | 5.5 | 5.5 | 4.00 | 16.00 | | | | | |
| **Assumptions (16)** | **Pre-test experimental** | 4 | 11.5 | 12.5 | 5.38 | 21.50 | 4.500 | 1.042 | 0.297 | - | - |
| | **Pre-test control** | 4 | 9 | 9.5 | 3.63 | 14.50 | | | | | |
| **Deduction (16)** | **Pre-test experimental** | 4 | 7.5 | 8.5 | 4.38 | 17.50 | 7.500 | -0.155 | 0.877 | - | - |
| | **Pre-test control** | 4 | 8 | 8.5 | 4.63 | 18.50 | | | | | |
| **Interpretation (16)** | **Pre-test experimental** | 4 | 8 | 7.5 | 4.75 | 19.00 | 7.000 | -0.300 | 0.765 | - | - |
| | **Pre-test control** | 4 | 7.5 | 7.5 | 4.25 | 17.00 | | | | | |
| **Arguments (16)** | **Pre-test experimental** | 4 | 9.75 | 9.5 | 4.00 | 16.00 | 6.000 | -0.581 | 0.561 | - | - |
| | **Pre-test control** | 4 | 10.25 | 9.5 | 5.00 | 20.00 | | | | | |
| **Test total (80)** | **Total experimental** | **4** | **42.75** | **42** | **4.75** | **19.00** | **7.000** | **-0.289** | **0.773** | **-** | **-** |
| | **Total control** | **4** | **40.25** | **40** | **4.25** | **17.00** | | | | | |

*Source*: Bunt (2019:301).
Significance: $p < 0.05$.

academic programme to which the participants were exposed possibly contributed to the improvement noted in the post-test results. These improvements were, however, not statistically significant.

Table 5.8 shows the comparison of the mean ranks between the different pre-tests of the experimental and control groups to determine whether the differences noted between the two groups were statistically significant.

Table 5.8 shows no statistically significant differences, $p < 0.05$, between the pre-test results for experimental and control group in relation to the five sub-tests on which the W-GCTA focused. It could therefore be concluded that both groups were more or less similar in terms of the development of their critical thinking skills at the outset of the research.

Table 5.9 shows the comparison of the mean ranks between the different post-tests of the experimental and control group to determine whether the differences noted between the two groups were statistically significant.

Table 5.9 shows that no statistically significant differences occurred between the post-test results for the experimental and control groups in relation to the five critical thinking skills on which the W-GCTA appraisal focused. In respect of all comparisons between the post-tests, it was noted that $p > 0.05$.

According to the interview data, using the Portal puzzle video game during the intervention to enhance the growth of critical thinking skills, dispositions and universal standards for reasoning showed general benefits, specific benefits and challenges. The general benefits included aspects of enjoyment, fun, excitement and happiness, as well as developmental achievement, challenge and accomplishment. In addition, the specific benefits included a number of *cognitive benefits* such as, cognitive demands, testing the mind, cognitive stimulation, enhancing thinking skills, cognitive improvement, independent thinking, goal-driven planning, accuracy, attention and improved concentration. The aforementioned benefits support what

**TABLE 5.9:** Comparison: Post-test results – Experimental and control group.

| Test | Groups | N | Mean | Median | Mean rank | Sum of ranks | Mann-Whitney U | Z | Significance (*p*) | *r* | Effect |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Inference (16)** | **Post-test Experimental** | 4 | 9.3 | 9.5 | 4.63 | 18.50 | 7.500 | -0.155 | .877 | - | - |
| | **Post-test Control** | 4 | 8.75 | 9.5 | 4.38 | 17.50 | | | | | |
| **Assumptions (16)** | **Post-test Experimental** | 4 | 10.3 | 10.5 | 3.88 | 15.50 | 5.500 | -0.749 | .454 | - | - |
| | **Post-test Control** | 4 | 11.0 | 11 | 5.13 | 20.50 | | | | | |
| **Deduction (16)** | **Post-test Experimental** | 4 | 8.0 | 7.5 | 4.50 | 18.00 | 8.000 | 0.000 | 1.000 | - | - |
| | **Post-test Control** | 4 | 8.0 | 8 | 4.50 | 18.00 | | | | | |
| **Interpretation (16)** | **Post-test Experimental** | 4 | 8.8 | 8.5 | 5.13 | 20.50 | 5.500 | -0.730 | .465 | - | - |
| | **Post-test Control** | 4 | 7.25 | 7 | 3.88 | 15.50 | | | | | |
| **Arguments (16)** | **Post-test Experimental** | 4 | 8.3 | 7.5 | 3.88 | 15.50 | 5.500 | -0.735 | .462 | - | - |
| | **Post-test Control** | 4 | 9.25 | 8.5 | 5.13 | 20.50 | | | | | |
| **Test total (80)** | **Total Experimental** | 4 | 44.7 | 43.5 | 5.13 | 20.50 | 5.500 | -0.726 | .468 | - | - |
| | **Total Control** | 4 | 44.25 | 41.5 | 3.88 | 15.50 | | | | | |

*Source*: Bunt (2019:303).
Significance: * $p < 0.05$.

transpired from the literature review, where the promotion of cognitive learning is highlighted as a positive effect of using games during teaching and learning (All et al. 2016:91; Granic et al. 2014; Green & Bavelier 2012; Hwang et al. 2015; Wouters & Van Oostendorp 2017). In addition, *emotional benefits,* such as motivation to learn, task involvement, engagement and experiencing fun, also transpired from the responses of the participants, supporting the viewpoints of Granic et al. (2014), Hwang et al. (2015) and Wouters and Van Oostendorp (2017) who highlight the positive emotional effects from including games during teaching and learning. A few challenges included game difficulty, discomfort playing the game, lack of time and understanding game expectations (Dewey 1910).

## Findings

The participants in the experimental group did not excel in the practical application of critical thinking skills in the pre- and post-tests, and differential growth in relation to the skills was noted among the participants after their exposure to the PVG-CEP intervention. Lack of growth in relation to critical thinking skills could imply that their skills to self-direct learning might therefore also be in need of more growth.

Making inferences appeared to be the only skill that developed among three of the four participants, namely, participants 1, 2 and 4, making deductions developed with one of the participants, participant 4, and doing interpretations only showed signs of growth for participant 4. Evaluation of arguments apparently did not benefit at all from taking part in the intervention. Participant 3 seemingly did not improve in the application of any of the critical thinking skills on which the research focused.

All the participants still need more exposure to develop intellectual autonomy and expertise over their thought processes to be regarded as self-directed learners who are sophisticated and advanced masters in thinking critically (Elder & Paul 2010).

The meta-cognitive skill of self-regulation that plays an important role in SDL (Du Toit-Brits 2018; Guglielmino 1997) could be developed stronger, to enable the participants to identify mistakes in their thinking (Facione 2009) and to continuously test whether their thinking adheres to the critical thinking dispositions and standards for reasoning (Elder & Paul 2010).

Taking part in the intervention proved to be more beneficial for the development of the critical thinking dispositions and standards for reasoning on which the research focused. From the interview data some dispositional elements such as paying attention (All et al. 2016; Granic et al. 2014; Green & Bavelier 2012) and motivation to be involved in goal-directed learning (All et al. 2016; Connolly et al. 2012; Granic et al. 2014) appeared to be aspects that seemingly benefitted from taking part in the PVG-CEP intervention and possibly contributed to the growth noted for the dispositions. In particular, motivation to be involved in goal-directed learning resonates well with one of the characteristics that a self-directed student should display (Du Toit-Brits 2018). Based on the data, the authors are of the opinion that the critical thinking skills that are important for SDL could be regarded as more challenging to develop in the context of a puzzle video game, than the dispositions and standards for reasoning.

Involvement in the puzzle video gameplay possibly contributed to developing personal characteristics in the participants upon which SDL is dependent, namely motivation, self-management, self-control (Garrison 1997; Guglielmino 1997) and emotional and intellectual autonomy (Caffarella 1993), as evidenced by the cognitive benefits cited during the interviews. In addition, certain process and context characteristics which are important for SDL were possibly also strengthened during the puzzle gameplay, such as controlling the planning and evaluation of learning (Obied & Gad 2017; Song & Hill 2007), formulating learning goals (Obied & Gad 2017) and critically questioning, analysing and reflecting about the learning situation (Hammond & Collins 1991).

The participants who took part in the research still require more opportunities to further develop their critical thinking skills that would strengthen SDL. The participants might still be ignorant of how their thinking is structured, how to assess its quality and how to further develop it (Paul & Elder 2006). It seems as if the participants need to develop an understanding of the problems in their thinking and acquire ways to address the problems (Elder & Paul 2010).

The participants seemed to have benefitted from a classroom atmosphere where a facilitation approach, independent learning and reflecting about thinking stood central (Brookhart 2010; Greene & Yu 2015; Mahapoonyanont 2012; Stoddar 2010). In support of the development of SDL, the PVG-CEP enabled the participants to take control of their own learning in a flexible environment (Beach 2017), which probably benefitted the growth noted for some critical thinking skills, dispositions and standards for reasoning that could lead to greater SDL.

## Recommendations

The findings of this small-scale research do not yet convincingly and conclusively indicate that puzzle video games hold benefits for advancing the development of higher-order critical thinking skills that are essential for SDL, through fun and motivating gameplay. Developing critical thinking that would strengthen SDL was detached from subject content (Marin & Halpern 2011) and showed only some signs of potential. For this reason, it could be argued that a combined embedded (Bensley & Spero 2014) and explicit approach to teaching critical thinking (Marin & Halpern 2011) might be more beneficial. The combined approach will allow more opportunities for practising the skills in different contexts, which might aid better retention of the critical thinking skills, dispositions and standards for reasoning that in turn could lead to greater benefits for SDL.

The element of independent, self-education in an enjoyable and experiential context that accompanied the video gameplay

(Cerasoli et al. 2014; Mardis 2013; Sherry 2001) could be regarded as instrumental for the growth noted in the development of some of the critical thinking skills, dispositions, standards for reasoning and subsequently SDL (Coombs, Prosser & Ahmed 1973; Rogers 2014; UNESCO 2012). However, it would seem to be more beneficial to combine informal and non-formal learning with a much stronger formal learning component, clearly conveying the intentionality (Isman & Tzuriel 2008) of the gameplay to the participants, to achieve greater benefits. Critical thinking skills could be taught (Bligh 2000; Boyles 2004), demonstrated (Bruce et al. 2009; McKee, Williamson & Ruebush 2007), modelled (Abrami et al. 2008; Zhao, Pandian & Singh 2016) and its application reinforced by means of guided and independent practice, to enable students to become better at the application of critical thinking, and consequently SDL, before exposing them to the puzzle video gameplay. In essence, the differential influence that the puzzle video game had on the development of critical thinking among students alerted the authors to the fact that a one-size-fits-all approach to developing critical thinking and subsequently SDL should not be promoted.

It is recommended that an interactive learning approach is added to the PVG-CEP intervention, or to anyone considering using Portal or any other puzzle video game in an educational manner. Interactive learning relies heavily on communication and interaction with participants. Learners and instructors may benefit from each other and improve cognitive knowledge and abilities and organise their ideas to build cogent arguments (Anon 2020b; Arends 2004; Kramer 2006). This was a limitation of this research, and further research could be conducted to establish the effect of participants working together to solve puzzles on the development of critical thinking and SDL.

The use of continuous purposeful questions to prompt critical reflection on action during the puzzle gameplay, and to present participants with more opportunities to critically reflect in writing about their gameplay, supplementary to the oral feedback used during the intervention, could present opportunities that might enhance participants' ability to become more effective at practising reasoning that is clear, logic and precise (Paul & Elder 2006).

Fahim and Hajimaghsoodi (2014) and Shamir, Tzuriel and Rosen (2006) contend that motivation and intention, respectively, are important preconditions to support the willingness to become involved in the application of critical thinking. As the authors did not establish the levels of motivation and intention at the outset of the study, it would be essential to establish the participants' levels of motivation and intention to become better at critical thinking, to gain a deeper understanding of the findings obtained.

## Conclusion

The present research into the development and application of critical thinking skills, dispositions and standards for reasoning that could strengthen SDL among first-year BEd students is open to further scrutiny. Little is known about the extent to which teacher-training programmes actually prepare students to think critically and to teach for critical thinking that would strengthen SDL. This research creates an awareness of the fragile nature of the elements of critical thinking that are important for SDL that need to be addressed among BEd students. What the findings revealed is that the most important challenge facing teacher education appears to be an intellectual and practical one. Strategies and tools have to be identified to improve the quality of pre-service teachers' critical thinking to benefit the manifestation of SDL. Pre-service teachers themselves need to become effective critical thinkers to promote skilled reasoning and intellectual self-discipline as well as self-reflective, self-directed, self-monitored and self-corrective thinking among students at schools. All higher education institutions should accept the challenge to direct the training of teachers to predispose them to be more adept at engaging in critical thinking and self-directed tasks.

Chapter 6

# Teachers' position regarding their curriculum as praxis: A self-directed learning capability perspective

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## Abstract

This chapter emanated from teachers' perspectives regarding their understanding of the South African intended curriculum and how they are implementing this curriculum. The current intended curriculum of South Africa is the CAPS. For this chapter, the teachers' position regarding their curriculum as praxis (which included curriculum implementation) was determined from a SDL capability perspective. This qualitative research was informed by using the capability theory as a conceptual framework. The participating teachers in this research were randomly selected from three departmental districts of the North West province of South Africa. An issue of control was noted in the literature, which also featured again in the data. The data indicated that while some teachers felt oppressed by the control that is exercised through the prescriptiveness of the CAPS (as an expectation from the Department of Basic Education), others experienced it as a challenge for improving their curriculum as praxis.


**Keywords:** Self-directed learning; Curriculum as praxis; Capability theory; Curriculum theory; Curriculum control.

## Introduction

Constant change in education is not a novelty and is still very pertinent in 21st-century education. The need for change in education is maintained in literature by Bolhuis and Voeten (2001), Guglielmino (2013), Hursen (2016) and Nasri (2017), amongst others. Hursen (2016) argues that education needs to be in accordance with the rapid changes in ICT; hence, it should be re-described. Nasri (2017) agrees that different roles and responsibilities need to be adopted by teachers, because active rather than passive learning methods should now be applied. Considering the South African context of our research, the capability approach asks what people are actually able to do and to be within their specific contexts and to consider which real opportunities are actually available to them (Nussbaum 2011).

The choices that are essentially available to people and which are not under control of other people are crucial within the capability approach (Kuklys & Robeyns 2010; Nussbaum 2011; Sen 1992). Sen (2004) describes being educated as a basic competence, which is fundamental to well-being.

## Problem statement

The Curriculum and Assessment Policy Statement (CAPS), which is the current intended curriculum of South Africa, provides teachers with comprehensive guiding principles regarding what to teach and assess. Emphasising the transition from the 'unstructured' outcomes-based curriculum to the CAPS, Janks (2014:12) states that the CAPS is overly prescriptive. Although the CAPS was aimed at simplifying the work of teachers (DBE 2011b:iii), there are concerns regarding the effectiveness of such an extremely prescriptive-intended curriculum. Janks (2014:17) explains that children have different abilities and interests, but with prescribed pacing, there is no focus on learners' creativity, imagination and innovation, skills that are crucial in the 21st century. Although the DBE (2011a) emphasises the necessity of developing active and critical learning, the CAPS stipulates the content, pace and pedagogy (Janks 2014). Thus, the research question to be discussed in this chapter is: what is the current position of schoolteachers' curriculum as praxis in North West, a province of South Africa, from a SDL capability perspective?

## Theoretical framework: Capability approach

The capability approach constitutes what people are actually able to do and to be within their individual contexts, and to consider which real opportunities are available to them (Nussbaum 2011:x). The choices that are available to individuals and that are not controlled by others are crucial within the capability approach (Kuklys & Robeyns 2010; Nussbaum 2011;

Sen 1992). Nussbaum (2011:152) explains that education has always been part of the capability approach, because through education, the capabilities that are available to individuals could be developed into 'internal capabilities' (Nussbaum 2011:152). Education, Nussbaum (2011) continues, comprises schools, family and educational programmes for children as well as adults. An important reason for applying the capability approach during our research was that the development of internal capabilities from available capabilities through education could provide lifelong satisfaction (Nussbaum 2011), also for teachers' curriculum as praxis.

## Origin and development of the capability approach

The capability approach, developed by Amartya Sen (an Indian economist and philosopher) in the 1980s, evaluates the individual welfare of people and provides a theoretical basis for inequality, poverty and policy analysis (Kuklys & Robeyns 2010:9). Robeyns (2005:94) defines the capability approach as 'a broad normative framework for the evaluation and assessment of individual well-being and social arrangements, the design of policies, and proposals about social change in society'. In the capability approach, people's welfare is assessed by considering their functioning and capabilities. 'Functionings' refers to what a person manages to do or to be; hence, his or her achievements (Kuklys & Robeyns 2010:10). Capability comprises the different functionings that a person can potentially achieve, while maintaining the freedom of such people to choose between different ways of living or exercising his or her choice in action (Kuklys & Robeyns 2010:10; Nussbaum 2011:18). It was important to consider both positions – functionings and capabilities – in this research in order to determine what teachers are able to do and achieve in terms of their curriculum as praxis. When greater freedom for people exists, progress or development could bring forth the critical change that is needed within teachers' curriculum as praxis (Alkire 2008:28).

Sen (2000:56) developed the capability approach in response to other approaches used to evaluate and measure well-being, because he assessed the information bases that were utilised for these other approaches. Income, for instance, was used in welfare economics as the information base for evaluation and, although income was acknowledged as a necessary resource for well-being, there were other components of well-being as well that were not directly accessible through income (Sen 1992:20). These components included being healthy and being able to make choices (Sen 1992:20). Sen further suggests that the focus should rather be on the 'quality of the lives of individuals' and the freedom they have to achieve the lives they want to lead, rather than only focusing on the 'meaning of a good life' (Sen 2000:73). The capability approach therefore focuses on removing obstacles in individuals' lives for them to be able to live the life that they value (cf. Robeyns 2005:94).

Furthermore, Nussbaum (1997, 2000a, 2000b, 2003, 2011) altered the capability approach towards human rights issues and human development of women and social justice. Sen's (1980, 1992, 2000, 2004) arguments are not all wrong, but Nussbaum (2003:35) states that Sen does not take us very far regarding thinking about social justice, nor about the minimum level of capability for a just society. As a result, Nussbaum (2003, 2011) developed a list of central human capabilities where she refers to the importance of education to be included within central human capabilities. Amongst others, Nussbaum (2003:41) states that senses, imagination and thought and using these in a 'truly human' way could be 'informed and cultivated by an adequate education'. This argumentation of Nussbaum (2003, 2011) underscores the necessity to include the capability approach in education, which she then discusses. It is thus, imperative to be educated as a basic human capability (Sen 2004:78). Kuklys and Robeyns (2010:10) support the research of Nussbaum and emphasise the importance of being well sheltered, being able to move around freely and being educated as part of an individual's functioning(s). Tao (2014:3) confirms this need for the capability approach in education by stating that Sen's (2000) altered view on well-being provided new insights into understanding human development and teachers' practices and behaviours in schools. In the next section, the central concepts of the capability approach are discussed.

## Central concepts of the capability approach

Wells (2015) explains the central concepts of Sen's (1980, 2000, 2004) capability approach, but other scholars' work will also be included here to emphasise the relevance of these concepts for this research.

### Capabilities and functionings

The capability approach operates on two levels, namely realised welfare (determined by functionings) and potential or feasible welfare (determined by capabilities) (Kuklys & Robeyns 2010:12). Affirmative governmental support is required for the creation and preservation of these capabilities (Nussbaum 2011:7). The concerns regarding educating learners for the 21st century can be tied up with the question as to what teachers are able to achieve: their capabilities, when viewed from the idea of the dignity of a human being, and a life that is worthy of that dignity (Nussbaum 2011:6–7). Esteve (2000:204) pre-empted the idea of teachers' capabilities, because teachers sometimes 'feel vulnerable and insecure' when they know about the advances and developments occurring every day. The capability approach considers each person individually, not only with regard to total or average well-being, but also in terms of the opportunities available to each person.

'Functioning(s)' on the other hand, can be explained to be states of 'being and doing', such as being well-nourished or having shelter (Wells 2015:1). Furthermore, functionings comprise different capabilities that a person could potentially achieve, while involving the freedom of the person to choose between different ways of living or exercising his or her choice in action. It was important to consider the capabilities from amongst which each participating teacher in our research could choose, while also recognising the functioning(s) they had already achieved in terms of being self-directed towards their curriculum as praxis. In this research, the teachers' quality of life as self-directed towards their curriculum as praxis was probed in terms of their own functioning(s) and capabilities.

## ☐ Valuation

It is vital to consider which functioning(s) matter for a good life. Underpinned by Sen's (2004) idea, the focus of evaluating the quality of people's lives should be their capability to live the life they have reason to value and not their resource wealth or subjective well-being (Wells 2015:1). Wells (2015:5) further states that we need a valuation procedure for determining the functioning(s) that matter for the good life and how much they matter. For the purpose of this research, the functioning(s) that matter for a teacher's curriculum practices to become his or her curriculum as praxis as part of living a 'good life' as a teacher were explored.

## ☐ Evaluation

While considering the capabilities of people, it is important to identify the set of valuable functioning(s) to which people have real access (Wells 2015:6). Sen (2004:77) argues that the assessment of capabilities could occur for different reasons, and that the selection of relevant capabilities and weighing them within differing contexts, should not occur without including discussions with the relevant people involved. Looking closer at the theory of evaluation or assessment, Sen (2004:78) states that identifying 'what we are free to do and free to be (the capabilities in general)', in relation to our material possessions and the commodities we can command, is a strenuous task.

Sen voices various concerns regarding contemporary approaches to the evaluation or assessment of well-being:

- individuals have different abilities for converting resources into valuable functionings
- some people internalise their circumstances and the harshness that they are experiencing, which leads them not to desire what they cannot expect to achieve
- people have valuable options, which are significant, even if people choose not to utilise such options
- the complexity of reality should be reflected in its evaluation rather than to exclude information in advance (Robeyns 2005; Wells 2015:1).

Sen's (2004:78) explanation provides two important ideas for our research. Firstly, he sees a direct link between the evaluation theory and the general capability theory (also called 'capability approach'). Secondly, the identification of capabilities, which people are free to utilise, could be a very difficult task. The next section of this chapter will shed some light on relevant criticism of Sen's capability approach.

## Criticism on the capability approach

Alkire (2008:28) explains the normative proposition of Sen's (1992) capability approach as when greater freedom for people exists, progress or development may occur. Sen (2000) considers the perspective of freedom when he argues that freedom is generally a good thing, for all purposes, and capabilities should form part of the general good of human freedom. Nussbaum (2003:33) assesses Sen's (2000) perspective of freedom by arguing that this perspective is too vague, and that some freedom limits others, 'some are central and some trivial, some good and some actively bad' (Nussbaum 2003:45). Nussbaum's (2003:44–45) reasoning is that while some businesses' had the freedom to pollute the environment, this might limit the freedom of other citizens to live in an unpolluted environment.

In our research, we agree with Nussbaum, because a general idea of freedom holds too many different meanings for different individuals. The South African DBE, for instance, has the freedom to provide schools with the explicitly prescribed curriculum documents for each teacher to follow. On the other hand, this freedom of the South African DBE might also limit teachers' control and choices to become more self-directed and thus autonomous regarding their own curriculum as praxis. Two concepts that emanated naturally from our research are 'control' and 'choices'. These will be discussed next to clarify how control underpins the theoretical perspective in terms of 'curriculum', 'praxis' and 'SDL'.

## Conceptualisation of control in 'curriculum' and 'self-directed learning'

Issues regarding control have been developing as long as education has been evolving. Some of these issues will be addressed in the next section by focusing on the philosophical background and influences of control, and control and choice in curricula. Control, choice and SDL will also be elaborated upon.

### Philosophical background and influences of control

Philosophical perspectives (idealism, realism, pragmatism, existentialism and postmodernism) and educational philosophies (perennialism, essentialism, progressivism, reconstructionism and critical theory) have continuously developed and diversified, influencing the diverse thoughts regarding curriculum domains and teachers' responsibilities (Verster, Mentz & Du Toit-Brits 2018). Initially, control featured in the literature regarding the major philosophical perspectives of pragmatism and postmodernism. Both pragmatism and postmodernism argue for the distinction between the traditional and contemporary influences (Gutek 2014) where (traditionally) teachers, in autonomous power positions, maintained control over their learners and (contemporarily) control was given over to learners to be able to learn how to self-control their own learning experiences (Grundy 1987; Tan 2006) in their journey towards growing into matured lifelong self-directed individuals.

In both philosophical perspectives, the learner's self-control became evident, in such a way that it was argued that the teacher's control could not be central to the educational experience anymore (Ornstein & Hunkins 2018). This division between the traditional view of maintaining control and the contemporary view of becoming a facilitator was also emphasised by Nasri (2017). When considering the requirements for teachers of the 21st century, as mentioned in the introduction and problem statement (see 'Problem statement' and 'Capabilities and functionings' sections), it seems clear that the requirements of the 21st century mostly resonate with the requirements of the contemporary philosophical period. Our argument regarding the issues of control will continue in the next section, which focuses on control and choice in curriculum.

## Control and choice in curriculum

The curriculum domains included in this chapter are curriculum development and curriculum implementation. The issue of maintaining control or giving control and choice to individuals in less powerful positions became more relevant when studying curriculum development as a domain of curriculum. Curriculum development naturally divided into the technical–scientific approach (traditionally philosophically underpinned) and the non-technical–non-scientific approach (contemporary philosophically underpinned). It was argued in the technical–scientific approach (Ornstein & Hunkins 2018) that the learning environment could be controlled, predicted and manipulated by a teacher (Frame 2003), while in the non-technical–non-scientific approach (Ornstein & Hunkins 2018), control should be shared with or given over to learners. When referring to the domain of curriculum implementation and the approach of curriculum implementation as instrumental action, which are also traditionally underpinned, the efficient ways of controlling learners and the learning environment to achieve predetermined outcomes, were highly criticised (Aoki [1983] 2005; Magrini 2015). The issue of control came to the fore even more specifically when curriculum as product, curriculum as practice and curriculum as praxis were contrasted.

## ☐ Control in curriculum: Curriculum as product

When we look at curriculum as product, it relates with the technical interest and positivism where control is enforced over individuals in a system (Grundy 1987; Makrakis & Kostoulas-Makrakis 2016). Curriculum as product can also be seen as a productive activity, resonating with the traditional major philosophies (idealism, realism), educational philosophies (perennialism, essentialism) and curriculum philosophies (scholar academic, social efficiency). Emanating from these traditional philosophical ideas, 'control' in an educational setting refers to teacher-centredness, because control is enforced over individuals' (i.e. learners') environment (Grundy 1987). In this product-oriented curriculum, teachers exercise firm control over the learning environment, because it is assumed that teachers alone have the knowledge that learners still have to obtain. The ends were therefore decided and the means directly planned before the actual event of teaching even started (Cornbleth 1988).

Phan, Lupton and Watters (2016:1257) confirm that the product-oriented curriculum is stationary and 'ready-made' before learning takes place. It is evident that a curriculum, designed to attain strictly set objectives, is fundamentally a technical interest similar to productive activity (Grundy 1987; Makrakis & Kostoulas-Makrakis 2016; Schwandt 2007:242). The learners' learning is so strictly controlled that a specific product by a learner can be produced at the end of the teaching process.

This technical interest that underscores the curriculum as product, directly relates to the subject-centred curriculum designs within schooling in the conservative tradition, the technical–scientific approach to curriculum development and curriculum implementation as instrumental action. This view of the curriculum is certainly too strict and limiting in the ever-changing 21st century.

## Control in curriculum: Curriculum as practice

A change occurred when the focus of education shifted from teaching-specified content to rather follow the process of learners' learning. The learning experiences of learners became pertinent (Phan et al. 2016). Relating to the practical interest, this was called 'curriculum as practice' (Grundy 1987:68). Knowledge is produced through meaning-making, and taking the right action within the environment is the purpose of the practical interest (Grundy 1987). Stenhouse's (1975) research informed the practical curriculum design, where the process of meaning-making occurs in interaction between the facilitator and the learners (Grundy 1987; Phan et al. 2016). A coherent curriculum can be generated by subtly assembling curriculum components, such as objectives, content and resources (Cornbleth 1988). Curriculum as practice is theoretically underpinned by the progressive ideas of the major philosophies (pragmatism, existentialism), the educational philosophy (progressivism) and the (learner-centred) curriculum philosophy. Regarding the curriculum domains, this process-oriented curriculum resonates with the learner-centred curriculum designs in the progressive tradition, the non-technical–non-scientific approach to curriculum development and curriculum implementation as mutual adaptation in curriculum implementation as situational praxis.

## Control in curriculum: Curriculum as praxis

The concerns that came with control changed when viewing the curriculum as praxis, where autonomy and responsibility for one's own learning became vital. According to this approach, individuals within a system have to start taking control of their own lives in an autonomous and responsible manner (Grundy 1987). A resultant transformation of consciousness occurs where people start to reflect and act on their environment in a different way, implying that they are no longer being oppressed by others (Grundy 1987). Aoki ([1983] 2005:116) refers to this as 'curriculum implementation as situational praxis'. It is the opinion of Themane (2011) that individuals' understanding of the curriculum is crucial for theorising, practicing and defining the curriculum. How teachers understand the curriculum, is critical for exploring how they function within their curriculum as praxis. Grundy (1987) contrasted curriculum as product with curriculum as practice and curriculum as praxis. She also drew from the ideas of Habermas (1972) to explain the relevant interests of education, referring to the technical, practical and emancipatory interests, which relate to the curriculum as product, curriculum as practice and curriculum as praxis respectively (Grundy 1987).

Regarding the curriculum domains, this reconstructive-oriented curriculum relates to the problem-centred curriculum designs in the radical tradition, the non-technical–non-scientific and critical emancipatory approaches to curriculum development and curriculum enactment in curriculum implementation as situational praxis. Thus, curriculum as praxis entails (Grundy 1987):

- action and reflection, where the curriculum is developing through the vigorous interactions of action and reflection, rather than being designed beforehand
- praxis taking place in real-world contexts, within real situations with real learner
- praxis operating in the world of interaction, socially and culturally
- the world of praxis that is constructed and knowledge is a social construction, because learners become active participants in constructing their knowledge
- praxis assuming a process of continuous meaning-making (pp. 114–116).

Teachers were traditionally seen as the main holders of knowledge, but currently they can also learn alongside the learners to be lifelong self-directed individuals. Therefore, curriculum as praxis supports teachers in understanding the 21st-century necessities more broadly.

## Control, choice and self-directed learning

A prominent and still highly valued definition of SDL that features often within this body of scholarship, is that of Knowles (1975) who describes SDL as the:

> [*P*]rocess in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. (p. 18)

More specifically, Bolhuis (2003:335) simplifies SDL as 'being in command of oneself, moving towards one's own goals'. From these definitions, it is already clear that having choices and being in control of one's own learning is inevitable for SDL to be successful. Some scholars argue that SDL is imperative for adult education (Krabbe 1983; Merriam & Bierema 2014; Straka 2000:242; Zepke & Leach 2002) whereas others, such as Bolhuis and Voeten (2001) and Van Deur (2018) argue for the importance of SDL to feature in educating children. Louws et al. (2017) explain teachers' SDL as accommodating the idea that teachers formulate specific learning needs for themselves from where they can direct their own learning. This idea of teachers' SDL is exactly that on which this research focused; therefore, we agree that SDL is vital for adult education as well as for educating learners, but for this research, we focused specifically on schoolteachers.

Krabbe (1983:373) and Teng (2019:1) strongly emphasise that the best way to enhance SDL in learners is to surround them with self-directed teachers. Consequently, it is important to realise that aims and objectives for enhancing SDL in learners directly have specific responsibilities for teachers' curriculum as praxis.

Hursen (2016:74) agrees that teachers need the same skills as the learners they are teaching, that is motivation, attitude and SDL. Some specific personality traits that were found in SDL are that such individuals (Guglielmino 1978, 2013):

- demonstrate initiative, independence and persistence in learning
- accept responsibility for their learning
- are capable of self-discipline
- have a high degree of curiosity
- have a strong desire to learn or change
- have self-confidence.

Along with the personality traits, Long (2000) refers to three primary dimensions of SDL. In short, these dimensions are motivation, metacognition and self-regulation. He defines *motivation* as the 'energy, drive or desire that encourages … an individual to accomplish a goal or task' (Long 2000:16) and *metacognition* as generally meaning 'thinking about thinking' where the person is conscious of how or what he or she is thinking (Long 2000:18). Long (2000:19) also views self-control as a prerequisite for *self-regulation*, because a person can regulate (or control) thinking while he or she may be aware of and think about his or her thinking. Prominent aspects of self-regulation include making choices between alternatives, attributing values to consequences of the chosen alternative and choosing between immediate and delayed consequences (Long 2000:20). He continues to elaborate on the four secondary dimensions of SDL, which are choice, competence, control and confidence (Long 2000). *Choice* could refer to how many choices the learner must participate at any level. It could also refer to the choices that are available within the learning format (Long 2000). *Competence* relates directly to the result of SDL (Long 2000). Making choices is a direct consequence of *control*; therefore, choice may be provided by the circumstances and '[c]ontrol may change the circumstances' (Long 2000:21–22). A *confident* learner is '[a] learner who has expectations of success [and one who] is more likely to try to learn than one who expects to fail' (Long 2000:22).

From this short explanation of Long's (2000) primary and secondary dimensions of SDL, it was evident that choice and control are pivotal for enhancing a person's SDL.

It remains evident in the SDL body of scholarship that individuals who have control over what they want to learn and how they want to learn it, are more prone and motivated to continue learning (Balaban Dağal & Bayindir 2016; Garrison 1997). Garrison (1997:21) states that control is central to SDL activities, although '[c]ontrol does not translate into social independence or freedom from influence'. In the research (Garrison 1997), it is seen that increased learner control brings increased responsibilities. Balaban Dağal and Bayindir (2016:398) concluded from their research, 'individuals with personal control show more control over their learning whereas individuals who believe in factors beyond personal control show lower levels of readiness during [the] self-directed learning process'. Furthermore, 'individuals with [a] high level of personal control have an impact on self-directed learning readiness' (Balaban Dağal & Bayindir 2016:399).

From this short discussion of SDL, it is already inevitable that SDL cannot be optimally experienced without having choices and being in control of one's own learning. Note, though, that having choices and being in control of one's own learning is not achieved as easily as might be perceived.

## Self-directed learning for teachers within the 21st century

It has been argued in the literature (Curran et al. 2019:75; Saks & Leijen 2014:190) that the ever-changing world is related to the digital revolution, where self-directedness and SDL have become imperative. Self-directedness and SDL are also often stated as important goals in school education (Van Deur 2018) and continuing professional education (Curran et al. 2019). As these educational goals gain prominence, learners should also learn to study more independently, which should prepare them better for higher education, work and life (Bolhuis & Voeten 2001:837; Curran et al. 2019; Van Deur 2018) in the 21st century. Confirming the argument of our research, Urban (2000:231) emphasises that schools have not changed, even though the empowerment of teachers, sharing decision-making with teachers and including teachers in site-base managements have been discussed exhaustively. The main concern stemming from this resistance to change is that 'the majority of teachers continue to teach the same way they have always taught' (Urban 2000:231). Nasri (2017) conducted a study about teachers' roles in promoting SDL amongst their learners, where it was concluded:

> [*S*]DL requires a transformation from the authoritative role of the [*teacher*] into the [*teacher*] as a facilitator of learning because, to promote an active learning approach, [*teachers*] should acknowledge learners as equal learning partners. (p. 3)

Therefore, teachers need to abandon their traditional authoritative roles by allowing and empowering learners to take control and responsibility of their own learning (Nasri 2017:3).

Nasri is also of the opinion that SDL could be fostered in the following ways. Firstly, teachers 'should establish a positive and collaborative relationship with the learner[s]', and teachers 'should recognize the available learning resources and restrictions within the actual learning context as this would allow for effective implementation of SDL' (Nasri 2017:7). Secondly, 'universities should play their part in assisting [teachers] to plan their teaching strategies, which facilitate the learners' learning direction by conducting ongoing, in-service training programmes, encouraging self-development, and supporting teachers to work alongside colleagues' (Nasri 2017:7).

It was concerning for us to realise that these developments in education, towards curriculum as praxis and SDL and the aspirations that it proposes for 21st-century education, seem quite strenuous for teachers. The problems related to teachers' professional development were illuminated by Louws et al. (2017:171) as:

- not involving teachers in the choice of content
- not taking teachers' needs into account
- seeing teachers as the receivers of professional development rather than as being actively involved
- not considering teachers' experiences sufficiently.

As a solution, Louws et al. (2017:172) suggest that teachers show high ownership when directing their own learning; therefore, the researchers explored the 'what', 'how' and 'why' teachers would want to learn. Variations exist in what teachers want to learn, especially when they have a choice about it (Louws et al. 2017:172). These variations comprise knowledge of subject content, classroom management, the curriculum, learners' learning processes, school organisation, learning about themselves as professionals and acting as mentors for novice teachers (Shulman 1986). While teachers could exercise a choice about how they would want to learn, Louws et al. (2017:172) follow the types of learning activities of Meirink et al. (2009) who distinguish:

- learning by experimenting
- learning by reflecting on one's own teaching practice
- learning from others, which could include interaction or not
- learning by doing.

To this, Louws et al. (2017) add keeping oneself up to date, which comprises reading professional literature and following training on one's own subject(s). Why teachers would want to learn is focused on the positive expectation that the learning will add value to a teacher's work environment, and that the learning will lead to the goal that they would want to achieve (Louws et al. 2017:172).

## Methodology

To determine the selected teachers' current position of their curriculum as praxis from an SDL capability perspective, working theories needed to be generated and then a promising theory had to be selected. The capability approach was selected as the theory and theoretical framework to explore these positions of teachers.

A basic qualitative research methodology (Merriam & Tisdell 2016:19, 23) was used to understand the meaning and experiences of teachers when implementing the CAPS and to determine the effect of SDL capabilities on teachers' curriculum as praxis.

The specific sampling strategies for this research are explained in the following section.

## Sampling

The four steps of sampling, as explained by Robinson (2014:25), were used in this research. *Step one*, defining a sample universe, involves the target group, which is determined by inclusion or exclusion criteria (Robinson 2014:26). The only inclusion criterion for this research was that teachers had to teach within the province of North West in South Africa. The *second step* was to decide on the sample size (Robinson 2014:25, 29), which in this research comprised 36 teachers. The sampling strategy, the *third step* (Robinson 2014:25, 32), constituted stratified sampling, where the groups of cases need to be decided. For this research, these groups included all four of the departmental school districts (Dr Kenneth Kaunda, Dr Ruth Segomotsi Mompati, Ngaka Modiri Molema and Bojanala) within North West. All schools teaching Grade 9 learners were then extracted so that three schools per departmental school district could be randomly selected. Merriam (2009:82) confirms that random sampling can be used within qualitative research. The *fourth and last step* was to recruit the teachers who were selected in the sample, which took place after all the ethical requirements had been adhered to. The first author held an informative presentation at each school where the principal and school governing body gave permission, as per the ethical requirements of the NWU. The teachers could then freely decide whether they wanted to participate. The teachers who were willing to participate then completed the consent form with the assistance of an independent researcher. Only the 16 teachers who provided informed consent to participate in the research, formed part of the sample.

## Trustworthiness of data from this research

The trustworthiness of the data from this research, and how we adhered to credibility, transferability, dependability and the confirmability are discussed in the next sections.

### Credibility

Credibility can be achieved through triangulation, member checks, alternative explanations or persistent observation, the researcher's position and peer examination (Babbie & Mouton 2008:277; Merriam 2009:215–219), and inquires how the research findings match reality (Merriam 2009:213).

For our research, member checks (Babbie & Mouton 2008:277; Merriam 2009:217) were important, because data, as well as the interpretations thereof, had to be verified with the research participants. Alternative explanations or persistent observations are important because interpretations in various ways should be pursued while also constantly and tentatively analysing the data (Babbie & Mouton 2008:277; Merriam 2009:219). This was done throughout this research. Credibility was assured by having a peer examination where a colleague of the first author scanned some of the raw data and assessed whether the findings were in accordance with the data, as explained by Merriam (2009:220).

### Transferability

The transferability of a qualitative study constitutes the possibility of the research to be executed in another context or with other participants (Babbie & Mouton 2008:277; Merriam 2009:223, 227). Assuring transferability of this research was addressed through maximum variation in the sample (Merriam 2009:227), which was done in our research by selecting different sites.

### Dependability

The dependability of a study relies on the results of the study and how consistent such results are with the data that had been collected (Babbie & Mouton 2008:278; Merriam 2009:221). Assuring the dependability of this study was done by way of peer examination, as was described in the 'Credibility' section.

### Confirmability

The degree to which the researcher's own biases are excluded from the findings, is referred to as the confirmability of the study (Babbie & Mouton 2008:278). The confirmability can be verified by a confirmability audit trail for evaluating the conclusions, interpretations and recommendations of a study (Babbie & Mouton 2008:278). In the current study, six classes of data were reviewed for this confirmability audit trail, namely the 'raw data', 'data reduction and analysis products', 'data reconstruction and synthesis products', 'process notes', 'material relating to intentions' and 'instrument development information' (Babbie & Mouton 2008:278). A complete paper trail that covered these six classes of data was developed and preserved throughout this research.

## Methods of data generation

For this study and as reported in this chapter, individual face-to-face semi-structured interviews were conducted by the first author and each participating teacher. These interviews were utilised for generating rich data from the participating teachers. Rich data can be generated by asking predetermined questions, while the researcher can probe and clarify the answers (Nieuwenhuis 2009a:87). These interviews thus provided an opportunity to probe and clarify the responses from the teachers.

The focus of these interviews was to explore the position of the participating teachers' SDL capabilities and their curriculum as praxis at the time of this research.

## Method of data analysis: Discourse analysis

Discourse analysis was applied for analysing the meaning of the spoken as well as the written word (Hyland & Paltridge 2011:1; Nieuwenhuis 2009b:102; Paltridge 2006:2). In our research, the spoken and written word comprised the transcriptions of the interviews. Discourse analysis may include additional critical and theoretical considerations for analysing institutionalised ways of thinking, which also define the social lives of people (Hyland & Paltridge 2011:1). Discourse analysis is further concerned with the effect of language during engagements between the world and people (Hyland & Paltridge 2011:1). These language engagements shape social, political and cultural formations within a society (Hyland & Paltridge 2011:1). The discourse analysis was positioned towards language formations that resulted from the data regarding the teachers' SDL capabilities in relation to the enhancement of their curriculum as praxis.

The interviews were audio-recorded by using a voice recorder and then transcribed verbatim, directly after the interviews had taken place. All the participating teachers consented for the interviews to be recorded. Jones (2011:11) confirms that the spoken language should become detached from the original context, and in discourse analysis, this detachment occurs when the discourse is generated with some sort of recording device, and then transformed into written text, which can be analysed.

The data were coded by making use of ATLAS.ti™, a computerised programme that is applied for qualitative data analysis. Initially, *a priori* coding (SDL_choice, SDL_control, Curriculum_choice, Curriculum_control, Praxis_action-reflection and Praxis_real-world) was used, but open coding was also used to avoid limiting the codes that came to the fore from the data, as confirmed by Saldaña (2016:115). These codes were then categorised to highlight the themes. Throughout this process of organising and coding the data, we were checking the coding of the data.

# Results

The results of this research will now be presented and discussed.

## Presentation of the interview data

The following overarching themes emerged from the analysis of the interview data, and are presented and discussed next.

### The personality traits of self-directed learners – Teacher capabilities

Half of the participating teachers (3, 5, 6, 9, 10, 12, 13 and 14) related to only one of the personality traits of a self-directed learner, namely a desire to learn and change; and taking initiative, independence and persistence in learning. Teacher 16 related to taking initiative and being independent and persistent in learning as well as to having self-confidence and self-discipline. Teacher 8 was the only teacher who related to four of the personality traits, namely a desire to learn and change; showing high curiosity for learning; taking initiative and being independent and persistent in learning and taking responsibility for their own learning. These traits are discussed below, with quotations from the participating teachers. Please note that all quotations are reproduced verbatim and unedited.

#### *Self-directed learning capability – Desire to learn and change*

Some of the participating teachers (5, 6, 8, 9, 10, 12 and 14) mentioned, directly and indirectly, that they had a desire to learn and change regarding different and new teaching–learning strategies, through furthering their own education, learning through workshops, learning from other schools and learning about developments in their subject. Referring to workshops, Teacher 9 voiced a desire to learn and change regarding new teaching–learning strategies, when stating, 'I would have preferred to learn about interesting methods to rather make the work more interesting and nicer for the learners. I have a need for that' (T9, teacher, January 2019). Regarding furthering their own education, Teacher 8 explained, 'so me enrolling for ACT [Advanced Certificate in Teaching] in Mathematics and after that Technology, related to the subjects I am teaching, that will empower me' (T8, teacher, May 2019). Teacher 14 referred to learning from other schools, when stating, 'collaboration between teachers within my school or within the neighbouring schools, [because] there are quite a few high schools here close by' (T14, teacher, January 2019). Furthermore, Teacher 9 expressed a desire to learn and change regarding one of her subjects, 'I wish I could be more up front with the sciences, especially about what is new and really happening … but, yes, I did fall behind a bit' (T9, teacher, January 2019).

While these teachers (5, 6, 8, 9, 10, 12 and 14) voiced a desire to learn and change, two of these teachers (9 and 10) also expressed comfort in their curriculum implementation. This comfort stemmed from the DBE expectations that are underpinned by the CAPS, the provided Annual Teaching Plan and the provided School Administration and Management System (SAMS). Teacher 10 stated that the SAMS:

> '[*T*]ells you which assessments the learners should do, and it fairly agrees with CAPS, but sometimes I feel you do have to do something extra, but I also feel that I have to stick with that [*SAMS*], because there is a reason why they want those specific assessments'. (T10, teacher, January 2019)

In this sense, as Teachers 9 and 10 felt comfortable about their curriculum implementation in terms of the DBE expectations, it could be deduced that they preferred curriculum implementation as instrumental action, as they would not have to learn and change much regarding their curriculum implementation, because the CAPS documents and expectations were provided to them. This lack of a desire to learn and change regarding curriculum implementation also featured in curriculum as praxis of these two teachers (9 and 10). Both teachers showed a relatedness to interaction (as an element of curriculum as praxis). Teacher 9 further related to real-world contexts (as an element of curriculum as praxis), but neither of them related to any of the other elements of curriculum as praxis (action and reflection, knowledge being constructed and meaning-making of knowledge). Referring to a neighbouring school, Teacher 10 said, ‘especially the one teacher, whom I see regularly, I can ask questions to’ (T10, teacher, January 2019). Regarding real-world contexts, Teacher 9 explained:

> ‘[*W*]e are now doing Financial Mathematics, so I try to give them [*learners*] real examples and ask them whether their parents ever speak to them about buying a car or a house’. (T9, teacher, January 2019)

From the teachers who expressed a desire to learn and change, five teachers (5, 6, 8, 12 and 14) indicated that they were directed by their own expectations rather than by expectations from the DBE for their curriculum implementation. The expectations Teacher 6 had of herself, were guided by curriculum implementation as instrumental action, because she calmly stated:

> ‘I give instructions. They [*the learners*] will do most of the work in class, so I will explain the concept, show them how to solve some problems, introduce a chapter and then they do all the work’. (T6, teacher, April 2019)

Teacher 6 revealed a lack of desire to learn and change regarding her curriculum implementation, but this was because she only expected herself to transfer the CAPS content rather than to make meaning of the content. This lack of a desire to learn and change shown by Teacher 6 had a clear influence on her curriculum as praxis, because she only related to interaction (as an element of curriculum as praxis), and only in the sense that her learners were sometimes grouped together, ‘[w]e know our learners so those who are weak, I would group them with stronger learners’ (T6, teacher, April 2019). Teacher 6 did not seem to practice any of the other elements of curriculum as praxis (action and reflection, real-world contexts, knowledge construction, meaning-making of knowledge).

Teachers 5, 8, 12 and 14, seemed to be directed towards curriculum implementation as situational praxis because of their own expectations. Teacher 14 expressed a desire to learn and change, because for her, learners should not only memorise facts, but also understand the reasoning behind why it is important to achieve specific outcomes. She said:

> ‘I like practical examples, so I want learners to understand why they are learning about photosynthesis or the body system and how it is of importance to them. Rather than just them knowing it, writing it in an exam, and just forgetting it’. (T14, teacher, January 2019)

These teachers (5, 8, 12 and 14) who seemed more directed by their own expectations than by those of the DBE, and who expressed a desire to learn and change, seemed to relate to more elements of curriculum as praxis compared to Teachers 6, 9 and 10. Teacher 8 revealed that she exercised action and reflection (element of curriculum as praxis) to be able to learn and change continuously, ‘I am an IT [Information Technology] person, so I don’t want to be behind, I don’t want to lack behind or remain in the dark’ (T8, teacher, May 2019). Teacher 8 also explained repeatedly that she incorporated 21st-century skills into her teaching, even though this was not expected by the DBE. Teacher 5 highlighted the relevance of real-world contexts (element of curriculum as praxis) when she explained:

> ‘Accounting, we can take a receipt and we can deal with it. They [*the learners*] bring receipts, we take a look at the receipts, and then they would realise that even a packet of sweets that you buy, whether it’s cheap or not, that it’s about VAT [*value-added tax*]’. (T5, teacher, April 2019)

All these teachers (5, 8, 12 and 14) realised the necessity of interactions with colleagues (element of curriculum as praxis).

Teacher 5 explained, '[w]hen I sometimes have issues, particularly concerning content, we normally discuss with others' (T5, teacher, April 2019). Furthermore, Teachers 8, 12 and 14 referred to the construction of knowledge (element of curriculum as praxis) that occurred between themselves and the learners or even between learners under the facilitation of teachers. Teacher 8 stated, 'what I actually expect from my learners, is for us to engage. I tell them that I am a mediator, they should not just rely on me' (T8, teacher, May 2019). From the interview data, it was clear that there were no evident links with meaning-making of knowledge (element of curriculum as praxis) by those teachers who identified a desire to learn and change. Further personality traits of self-directed learners that were only somewhat referred to, were initiative, independence and persistence in learning, as will be elaborated next.

### ***Self-directed learning capability – Initiative, independence and persistence in learning***

Teachers 3, 8, 13 and 16 presented initiative, independence and persistence in their learning relating to their own lesson planning as well as in their own development and in that of learners. Regarding her own lesson planning, Teacher 3 stated:

> '[*W*]hat I do, is I look at the CAPS requirements and the prescribed textbook and I still make it my own. So, resources are from the internet and lecturers who taught me at university, otherwise, I do not have other support'. (T3, teacher, February 2019)

Teacher 8 clarified, 'as a teacher, I took an oath … we [teachers] are lifelong learners and when you are a lifelong learner you are a researcher' (T8, teacher, May 2019).

Although these teachers (3, 8, 13 and 16) showed initiative, independence and persistence in their learning, Teachers 13 and 16 also conveyed comfort regarding their curriculum implementation. This comfort was underpinned by DBE expectations, because Teacher 16 explained:

> '[*W*]e do get our annual teaching plan. The way it is designed helps you, even your pace, you must know that by this week I must have

> done this and then if you are behind it is helping you to try and move faster and if you are ahead then you can maybe give your learners more activities to be sure that whatever they did, they understood'. (T16, teacher, January 2019)

With such a sense of comfort that Teachers 13 and 16 were experiencing regarding curriculum implementation, it seemed that they preferred curriculum implementation as instrumental action. This limited position regarding showing initiative, independence and persistence in learning also influenced the curriculum as praxis of Teachers 13 and 16, but not in the same sense. Teacher 13 only presented action and reflection (element of curriculum as praxis) regarding changing her filing structure and her interaction (element of curriculum as praxis) with a retired teacher who used to teach Technology. Teacher 13 stated, 'with Technology, I have this other teacher who taught it, with whom I can talk' (T13, teacher, January 2019).

On the other hand, Teachers 8 and 16 presented action and reflection (element of curriculum as praxis) regarding implementing collaborative group work as well as interaction (element of curriculum as praxis) with colleagues at other schools as well as subject advisors and real-world contexts (element of curriculum as praxis). Teacher 16 explained that she applied group work in her class, which she learnt from other teachers, 'I've learnt that from group discussions, when we as teachers meet… It's working' (T16, teacher, January 2019). Teacher 16 continued with an example of learners having to conduct interviews, '[t]hey must interview their parents, they must go and ask for permission to interview, write the thank you letter, and so on' (T16, teacher, January 2019). Even though Teacher 16 expressed comfort in terms of the DBE expectations, her own expectations supported her to enhance her curriculum as praxis.

Furthermore, although Teacher 3 revealed initiative, independence and persistence in learning, she only related to interaction (element of curriculum as praxis) with colleagues from other schools, but with none of the other elements of curriculum as praxis.

### ☐ *Self-directed learning capabilities – Self-confidence and self-discipline*

Teacher 16 was the only teacher who presented self-confidence and self-discipline in implementing learner-centred teaching–learning strategies. As was explained above, Teacher 16 revealed comfort in terms of the DBE expectations, although her expectations of herself guided her to enhance her curriculum as praxis. Teacher 16 explained that construction of knowledge occurred between the learners, while doing group work, because she said, '[t]o be fair, I love to do that [group work], because when they [learners] are in groups they feel like they own [the responsibility to learn and contribute]' (T16, teacher, January 2019).

### ☐ *Self-directed learning capabilities – Responsibility for own learning and high curiosity*

Teacher 8 was the only teacher who demonstrated taking responsibility for own learning and having a high curiosity regarding 21st-century developments. She stated:

> 'I always come and try to teach them [*learners*] the new skills of the Fourth Industrial Revolution, which is inclined to how to use these devices that they have... teaching them how to research'. (T8, teacher, May 2019)

She continued:

> 'I think because I am an IT person and I can access whatever I need, if I am not informed. That is the principle that I am trying to instil in my learners'. (T8, teacher, May 2019)

Through the data analysis, it became clear that the personality traits of self-directed learners were capabilities available to all the participating teachers at the time of this research. However, few of these personality traits could be determined as already being definite functioning(s) of the participating teachers. Moreover, the data analysis regarding the personality traits of self-directed learners revealed that six of the 16 teachers (1, 2, 4, 7, 11 and 15) did not present any of the personality traits of a self-directed learner, even though they were asked the same interview questions. All of these teachers (1, 2, 4, 7, 11 and 15) did however, present dimensions of SDL, as will be explained next.

## ☐ The dimensions of self-directed learning – Teacher capabilities

It was discussed earlier that SDL has three primary dimensions (self-regulation, metacognition and motivation) and four secondary dimensions (control, choice, competence and confidence). Although not all of these dimensions were evident in the interview data, the necessity of these dimensions as possible SDL capabilities to enhance teachers' curriculum as praxis was still evident. The relationships between these SDL dimensions and participating teachers' curriculum as praxis, are discussed next.

Regarding the concepts 'control' and 'choices', it is important to refer back to where it was extensively discussed that 'control' and 'choices' naturally originated from our research, but from different roots (philosophical, curriculum, SDL theoretical and capability theoretical). Both these concepts also featured specifically as secondary dimensions of SDL. The reason for highlighting these diverse roots of both concepts is that these roots also had an influence on the coding and analysis of the data of our research. Although control, as a secondary dimension of SDL, specifically implies the control someone has over his or her own learning, it was also clear that external factors on control could influence teachers' capabilities to exercise own control in their curriculum as praxis. These internal and external factors regarding control featured in the interview data, and are presented and discussed next.

### ☐ *Self-directed learning capability – Control*

Most of the participating teachers (1, 2 and 5–15) experienced control regarding their own curriculum planning (curriculum design), because of the DBE expectations. It was alarming, however, that Teachers 1, 6, 9, 10 and 11 experienced this control as positive and comforting for their curriculum design and implementation. Teacher 11 shared, 'I like the fact that the CAPS books tells you exactly what the child should learn. That helps a lot' (T11, teacher, January 2019). This comfort in being controlled by the DBE expectations related to the traditional view on curriculum and curriculum as product and practice, rather than curriculum as praxis. The passiveness of these teachers (1, 6, 9, 10 and 11) to exercise control over their own curriculum design and implementation, was directly visible in their curriculum as praxis. It seemed that the external control from the DBE expectations inhibited these teachers' capability to exercise control over their own curriculum as praxis. These teachers (1, 6, 9, 10 and 11) all seemed to realise that interaction occurs between themselves and colleagues, colleagues at other schools and subject advisors and between learners within their classroom. Teacher 1 stated, 'we have much contact with other schools and other districts' (T1, teacher, February 2019). Unfortunately, these teachers (1, 6, 9, 10 and 11) did not mention any of the other elements of curriculum as praxis (action and reflection; construction of knowledge; meaning-making).

Teachers 2, 5, 7 and 12 seemed frustrated and limited by the control experienced because of the DBE expectations. Teacher 7 stated, 'we have to follow the CAPS document' and 'we don't become successful, because it is inflexible with the work, but we have to abide' (T7, teacher, May 2019). The teachers who seemed limited by this control, still seemed to exercise curriculum as praxis, more than curriculum as product or practice. They (Teachers 2, 5, 7 and 12) seemed to exercise action and reflection, because as Teacher 7 explained, for every topic and assessment, she would do an analysis to determine whether the learners understood the content, 'I do an analysis, like item analysis ... I try to find out how did they [learners] fare. ... that gives me direction about whether they are lacking something that needs to be revised' (T7, teacher, May 2019). Teachers 2, 5, 7 and 12 also realised the relevance of real-world contexts. Teacher 12 explained, 'I want a child to be able to articulate what he is thinking. That is what you communicate with' (T12, teacher, January 2019). These teachers also identified being in interaction with colleagues, other schools, subject advisors, within their classroom and with the internet. Teacher 7 stated, '[t]here are support systems … every quarter we attend workshops and then … we present our difficulties. … They give us ideas on how to go about it' (T7, teacher, May 2019). Even though no mention was made of knowledge being constructed or meaning-making of knowledge occurring, Teachers 2, 5, 7 and 12 seemed to have more control regarding their own curriculum as praxis than Teachers 1, 6, 9, 10 and 11.

Another feature of control that became clear from the interview data was that most teachers (2, 4, 5, 6, 7, 9, 10, 11 and 13) experienced comfort in having control over their learners in the classroom. Teacher 11 explained regarding her curriculum implementation, 'it is basically a presentation, then they [learners] will do that work and then I mark … basically. And then revise again' (T11, teacher, January 2019). This control, exercised by the teacher as an autonomous person in the classroom, refers to the traditional influences on education and curriculum. Therefore, it could be deduced that these teachers were probably quite traditional regarding their curriculum implementation. These teachers' connections with the elements of curriculum as praxis, as was discussed above, supported the traditionalism of their curriculum implementation, and therefore their curriculum as product and practice rather than curriculum as praxis.

An important point for discussion that arose from the interview data is that the participating teachers' perspectives regarding control did not include the essence of control as a secondary dimension of SDL.

### □ *Self-directed learning capability – Choice*

Teachers 2, 3, 4, 7, 8 and 13 acknowledged that they had choices, but these included choices regarding their own curriculum planning and implementation, by adding resources and trying to adapt to the learning barriers of the learners. Teacher 7 elucidated:

> '[*O*]ur learners are from different backgrounds. … [*W*]e are guided to firstly understand their backgrounds, so that when we teach, we try to find out about their different learning barriers. We teach according to their barriers'. (T7, teacher, May 2019)

Evidently, these choices only constituted adding ideas to the existing DBE expectations, which confirmed that these teachers were not able to exercise freedom of choice as an SDL capability regarding their own curriculum as praxis.

### ☐ *Self-directed learning capabilities – Competence and confidence*

Only two teachers showed competence regarding drawing from their own higher education (Teacher 13) and their own curriculum planning and implementation (Teacher 16). Teacher 13 stated, 'I refer back to my own work and what I learned when I was studying at university' (T13, teacher, January 2019). Teacher 16 seemed to be implementing quite effective learner-centred strategies with competence and confidence when she explained,

> '[*S*]omeone will represent the group as a group leader and then it doesn't mean the rest of the class doesn't have to take part … So I've found it to be very easy'. (T16, teacher, January 2019)

### ☐ *Self-directed learning capabilities – Self-regulation, metacognition and motivation*

The primary dimensions of SDL did not emerge, except for Teacher 8 who presented being quite motivated. She stated, 'teaching is my calling. I am very passionate about it, very passionate' (T8, teacher, May 2019). Although not all the primary and secondary dimensions of SDL came forward from the interview data, these dimensions seemed to be viable available capabilities for the participating teachers.

## Discussion of the interview data

Firstly, from the interview data, it became clear that whenever the participating teachers presented with a lack of SDL capabilities, a limited position in terms of SDL capabilities or a passiveness towards SDL capabilities, their curriculum as praxis was only somewhat visible. Curriculum as praxis for these teachers only related to the first three elements of curriculum as praxis, namely, to exercise action and reflection within real-world contexts, while interacting with other people.

To exercise action and reflection seemed to be challenging for some teachers, because they seemed to reflect often, but the reflection rarely seemed to influence their action. Teacher 9 acknowledged that she had fallen behind regarding some of the subjects she was teaching at the time of this research (reflection), but she did not seem motivated to change this position (action).

To teach within a real-world context and in interaction with other people, especially learners, are conditions for any classroom context. However, if teachers were exercising curriculum as praxis and thus curriculum implementation as situational praxis, they would also acknowledge the need for real-world contexts to be included and incorporated in their curriculum implementation so that their teaching could be more meaningful.

It was discussed earlier (see 'Control in curriculum: Curriculum as praxis') that effective praxis cannot occur without interaction between teachers and other people, and interaction featured in all the teachers' reporting. Teachers referred to interaction taking place in their classrooms, between themselves and the learners, but most of the teachers mentioned having positive interaction with colleagues as well as with colleagues from other schools and subject advisors.

Construction of knowledge was not evident in the interview data, although teachers mentioned it, as explained above. The fifth element, meaning-making of knowledge, was not mentioned at all. It was concerning to realise that the essential elements of curriculum as praxis only featured superficially in the interview data, except for interaction, which seemed to occur often between teachers. This was concerning because, as was elaborated earlier (see 'Control in curriculum: Curriculum as praxis'), all the elements of curriculum as praxis are vital for meaning-making of knowledge and for education in the 21st century.

Secondly, the above presentation of the interview data also highlighted that not all the participating teachers revealed limited, restricted and passive positions regarding SDL capabilities and, hence, their curriculum as praxis. Teachers explained that they took responsibility for their own curriculum as praxis, rather than to be limited by the DBE expectations, and they presented more of the SDL capabilities (desire to learn and change; initiative, independence, persistence in learning; self-confidence; self-discipline; responsibility for own learning; high curiosity). They also seemed to exercise essential elements of curriculum as praxis (action and reflection; real-world contexts; interaction and construction of knowledge) and it appeared that they had control over some elements of their curriculum as praxis.

Thirdly, the impression was given by four teachers that they were reluctant to take control of their own curriculum as praxis, because of the overwhelming external expectations posed by the DBE. Only interaction (element of curriculum as praxis) featured with these teachers, and one of these teachers also associated with real-world contexts (element of curriculum as praxis). In contrast, there were also teachers who seemed frustrated by the control exercised by the DBE expectations, and they took more control of their own curriculum as praxis (action and reflection; real-world contexts; interaction). It was also found that none of the participating teachers seemed to take control of their own learning, as a secondary dimension of SDL, although these teachers took control of some elements of curriculum as praxis.

If teachers are not able to take control of their own learning, then they are not able to change their circumstances (Long 2000:21–22), or their own complete curriculum as praxis. Therefore, the choices that might be available to them to realise as part of their SDL capabilities, might be restricted by this lack of control. Consequently, the participating teachers who referred to having choices, only exercised superficial choices regarding adding to existing DBE expectations and the lack of freedom of choice regarding their curriculum as praxis.

Fourthly, from the presented data, it was clear that teachers who had a traditional curriculum stance only related to the prominent SDL capabilities of having a desire to learn and change, and the secondary SDL dimensions of being under control while only exercising limited choices. On the other hand, there were also teachers who seemed to have a contemporary curriculum stance, and they related to more SDL capabilities than the traditional teachers. Other SDL capabilities to which the contemporary teachers related were the personality traits of:

- having a high curiosity for learning
- showing initiative, independence and persistence in learning
- taking responsibility for their own learning
- having some self-confidence and self-discipline
- having the primary SDL dimension of motivation
- having the secondary SDL dimensions of competence and confidence.

It was discussed earlier (see 'Control in curriculum: Curriculum as praxis') that the traditional or contemporary stance of teachers could influence their understanding of curriculum as praxis. The interview data confirmed this. It was thus clear that, during the interviews, most of the participating teachers seemed to be traditional in their curriculum understanding, which influenced their curriculum implementation and, consequently, their curriculum as praxis. The SDL capabilities were also not fully utilised, although these capabilities seemed to be available to the participating teachers.

## Conclusion

We would like to emphasise the relevance of teachers gaining control and autonomy over their own curriculum as praxis. In addition, the choices that are available to teachers, within their capabilities, should also be considered and taken into account, although the prescriptiveness of the CAPS counteracts these capabilities of teachers to enhance in 21st-century education. In this chapter, it was emphasised that some of the participating teachers found the CAPS to be 'inflexible'. Even though some other teachers said that the CAPS was too prescriptive, they did not seem to be limited or restricted by it.

In conclusion, it was clear that teachers with a traditional curriculum stance only utilised limited SDL capabilities, while teachers with a contemporary curriculum stance utilised more SDL capabilities. Furthermore, it could also be deduced that teachers who utilise only a few SDL capabilities, are traditional in their curriculum stance, and teachers who utilise more SDL capabilities, are contemporary in their curriculum stance. Therefore, if teachers' SDL capabilities could be exploited, their curriculum as praxis would develop concurrently.

## Acknowledgement

'Control in curriculum: Curriculum as product', 'Control in curriculum: Curriculum as practice' and 'Control in curriculum: Curriculum as praxis' sections are based extensively on Wolhuter (ed. 2018).

Chapter 7

# A Cultural-Historical Activity Theory gaze at teacher professional development to enhance self-directed learning and its transfer to the classroom

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# Abstract

This chapter reports on QUAL-quan mixed methods research findings (where the emphasis is placed on the qualitative (QUAL) data, and supplemented by quantitative (quan) data) on the role of a short learning programme (SLP) on Natural Sciences teachers' classroom practices. The SLP was designed to provide teachers with more nuanced knowledge and skills to contextualise curriculum themes through the infusion of indigenous knowledge, and to utilise inquiry learning and CL approaches to enhance SDL. A total of 128 Natural Sciences teachers participated in the research reported on, and data were collected from teacher interviews conducted before and after the SLP, open-ended questionnaires, lesson observations and an analysis of teachers' portfolios. Cultural-Historical Activity Theory was used as a research lens. The research reports on two cycles of interventions as part of a large design-based research study, and the affordances of CHAT in design-based research are illustrated. The CHAT analysis highlighted several tensions within the two activity systems (the SLP and the teachers' classrooms after the SLP, respectively), which contributed to the intended curriculum not being realised. Although this was true of both cycles, the second cycle provided more evidence of transformed teaching and learning practices, albeit not nearly to the extent that the intervention intended. The enacted curriculum that materialised in many classrooms provided evidence that teachers often fell back on transmission-mode approaches, at the expense of more learner-centred approaches that were emphasised during the SLP. The versatility of CHAT as a research lens is illustrated in the chapter, and both internal and external tensions that influence the realisation of the activity system's object are explored. We conclude this chapter by focusing on the affordances of CHAT as a research lens in SDL inquiries.

**Keywords**: Cultural-Historical Activity Theory; Teacher professional development; Inquiry learning; Cooperative learning; Indigenous knowledge; Self-directed learning.

## Introduction: The chasm between the intended and enacted natural sciences school curriculum

The South African school curriculum (the CAPS) envisages learners who can identify and solve problems and work effectively as members of a team, which implies that they should be self-directed learners (Department of Basic Education 2011a, 2011b). Furthermore, the curriculum envisages scientifically literate learners who appreciate the role of science in their daily lives. However, research studies such as those of Ramnarain and Schuster (2014) and White and De Beer (2017) show that there is conflict between the intended and the enacted curriculum, and that the lofty goals captured in the CAPS are often not achieved in Natural Sciences classrooms.

Molapo and Pillay (2018) highlight that there are often:

> [/]nconsistencies between the 'optimistic' view of the Department of Basic Education to improve curriculum implementation despite continuously changing the curriculum, and the 'pessimistic' scenario where educators consistently refer to obstacles to curriculum implementation. (p. 1)

These authors show that the ambitious outcomes stipulated in policy documents are often not realised at the coalface of teaching and learning in the classroom.

Spaull (2013:6) claims 'that South Africa has the worst education system of all middle-income countries that participate in cross-national assessments of educational achievement', and illustrates this point by sharing gloomy statistics; research shows that, out of every 100 learners who start Grade 1, only 50 will progress to Grade 12, and 40 will pass, but only 12 will meet the entrance requirements for tertiary studies. It thus means that merely 12% of children who start their schooling careers are provided the opportunity to continue with university studies.

Statistics also show huge differences in performance in various provinces. Spaull (2013) emphasises the fact that the Trends in

International Mathematics and Science Study (TIMSS) (2011) study showed that the average Grade 9 learner in the Eastern Cape was, in terms of learning, 1.8 years behind the typical Gauteng province learner. The overall pass rate in the 2018 Grade 12 examinations was 79.4%. Gauteng performed well above this average, with a pass rate of 89%, while the pass rate in Limpopo province was 70.6% in 2018, and that of the Northern Cape 75.2% (News 24 2019). Because both Limpopo and the Northern Cape's pass rates were below the national average, we decided to address our efforts, reported on in this chapter, to these two provinces.

The study conducted by McKinsey and Company (Barber & Mourshed 2007) makes it clear that an education system can only be as good as the quality of its teachers. In order to improve the quality of science education in South African schools, it is of utmost importance to prioritise teacher education. This research study reports on a SLP for science teachers which was conceptualised to provide teacher professional development in terms of equipping them with the knowledge and skills to better prepare learners for the demands of a complex 21st century.

## Problem statement

The CAPS (Department of Basic Education 2011a:4) for Natural Sciences (Grades 7—9) envisages 'learners with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society'. It advocates for 'an active and critical approach to learning, rather than rote and uncritical learning'. Furthermore, it expects learners to be critical and creative thinkers who can solve problems (Department of Basic Education 2011a, 2011b:5). It also places a high premium on valuing indigenous knowledge (IK) systems (Department of Basic Education 2011:5). However, the research of Molapo and Pillay (2018) indicates that there exists a misalignment between the intended and the enacted school curriculum. These authors indicate a number of reasons for this unfortunate state of affairs, such as the inadequate training of teachers, lack of resources and teachers' frustration with too much paperwork. A particular problem in Natural Sciences is the misalignment between the focus of CAPS on scientific literacy and having a nuanced understanding of the nature of science, and the chalk-and-talk approaches that often characterise science classrooms. The CAPS (Department of Basic Education 2011a, 2011b:10) envisages that 'learners should be able to complete investigations, analyse problems and use practical processes and skills' in evaluating solutions, and furthermore have an understanding of the role of science and IK in our everyday lives. Unfortunately, inquiry learning that builds on the tenets of science is often replaced by transmission-mode, 'teaching-to-the-test' practices. Cronje (2015) and Motambatamba (2018) show that science teachers often hold underdeveloped or even naïve views of the nature of science and IK, and this is one of the reasons for the marginalisation of inquiry learning. However, Ramnarain and Schuster (2014:631) draw attention to a second reason for displacing open inquiry learning with transmission-mode teaching and learning (which they refer to as 'didactic direct' approaches), namely systemic pressures on teachers to 'teach to the test', to ensure that learners do well in summative assessment opportunities.

In order to address the concern that some teachers are not adequately trained to facilitate inquiry learning, or to effectively infuse IK into curriculum themes, an SLP was developed to assist teachers in obtaining knowledge and skills to do so, as will be discussed later in this chapter.

Literature suggests that SLPs are often not effective in changing the pedagogical orientations and classroom practice of teachers (Centre for Development and Enterprise 2011). This research explored the tensioned space between the intended curriculum of the SLP, and the enacted curriculum that materialised in teachers' classrooms after the SLP.

The primary research question that guides the research reported on in this chapter is: what insights does CHAT as a research lens provide into transformed teaching and learning after a professional development intervention?

# The theoretical and conceptual frameworks that underpin this research

Social constructivism was used as a theoretical framework in this research. Our conceptual framework included teacher professional development, SDL, IK and active teaching–learning strategies.

## The theoretical framework: Social constructivism

Social constructivism constitutes the theoretical framework of this intervention. We focused on how teachers' learning can be scaffolded across the zone of proximal development (Vygotsky 1978). We support the notion that knowledge is socially constructed in collaboration with others during shared experiences where new knowledge is built on existing or previous knowledge. Our approach was that, in Vygotskyan parlance, knowledge is firstly constructed on a social plane, and then later internalised (the personal plane). We therefore developed our SLP intervention for teachers to work together cooperatively while solving problems and completing inquiry learning tasks.

## The conceptual framework for this research

### Teacher professional development

Darling-Hammond and McLaughlin (2011) describe teacher professional development as a variety of learning experiences designed to improve practice. Patton, Parker and Tannehill (2015) mention different embedded models of professional development that are effective in transforming teaching practices, such as action research approaches, networking (within communities of practice) and self-monitoring and self-reflection. Patton et al. (2015:2) make the statement that 'teachers enter professional development as self-directed learners with previous experience, defined expectations for their learning outcomes, and a willingness to collaborate with teaching colleagues'. When conceptualising the SLP, we also drew on the insights offered by the 'Target Inquiry at Miami University' project, which focused on enhancing inquiry-based teaching approaches through teacher professional development. All these insights guided us in developing the SLP – refer to paragraph 4.

## Self-directed learning

In this research, we subscribe to SDL as described by Knowles (1975), namely as the:

> [*P*]rocess in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating outcomes. (p. 18)

Self-directed learners take ownership of their own learning rather than waiting for a teacher to prescribe what needs to be learned. According to the needs of the 21st century, teachers should obtain the necessary skills to be innovative, creative, critical thinkers with inquiring minds and self-directed in their own learning in order to also foster these skills among school learners (Lamb, Maire & Doecke 2017). The intended South African school curriculum envisages learners who can identify and solve problems and work effectively as members of a team (Department of Basic Education 2011a, 2011b), thus requiring that the learners are self-directed. The awareness of and ability to foster SDL should therefore be part of any teacher professional development programme.

## Active learning to enhance self-directed learning

To foster SDL, there should be a transformation from a teacher-centred approach to a learner-centred approach, where the authoritative role of the teacher changes to that of facilitator of learning (Nasri 2017). Learners should be actively involved in their own learning – that is, taking responsibility and ownership of their learning. Johnson and Johnson (2017) argue that within teacher professional development:

> [*T*]he pedagogy most appropriate for socialising teachers into a community of practice, creating an identity as a teacher, building commitment to be an effective professional and accomplishing other important goals is *cooperation*. (p. 285; [*authors' added emphasis*])

Teaching–learning strategies within an active learning environment, and building upon cooperation, include PBL, inquiry learning and CL. These strategies empower learners to take responsibility for and control of their learning while working closely together with their peers. Problem-based learning, according to Krajcik and Shin (2014:275), engages learners to 'actively construct their understandings by working with and using ideas in real-world contexts'. It is centred on a driving question, a problem to be solved. Inquiry learning implies that student-centred learning is combined with discovery, and such learning nurtures the development of independent learners, who take responsibility for their own learning (Smallhorn et al. 2015). Inquiry learning is well-aligned with the tenets of the natural sciences. As Smallhorn et al. (2015) allude:

> [*B*]ased on the principles of the scientific method, in inquiry-based learning students observe a phenomenon, synthesise research questions, test these questions in a repeatable manner and finally analyse and communicate their findings. (p. 66)

Cooperative learning refers to a learning process where individuals work together to collectively solve a problem or achieve a shared goal (Jolliffe & Snaith 2017). Johnson and Johnson (1996:786) identified five elements that characterise CL, namely positive interdependence among group members, promotive face-to-face interaction, individual accountability, interpersonal and small-group skills and group processing. These elements should enhance cooperation in any collaborative learning environment.

### Indigenous knowledge

Agrawal (1995:418) describes IK as 'the common sense knowledge and ideas of local peoples about everyday realities of living'. Vadigi (2016) advocates for an all-inclusive research model that acknowledges diverse knowledge systems. The latter author highlights the fact that the amalgamation of IK systems with modern scientific systems is likely 'to strengthen socio-ecological resilience through the development of sustainable environmental management strategies' (Kruger & De Beer 2019; Vadigi 2016:148). In science education literature, several scholars (Cronje 2015; De Beer 2015; Le Grange 2019) advocate for the border-crossing between 'western science' and IK in the Natural Sciences classroom. These scholars show that IK holds the potential to better contextualise an abstract curriculum to culturally diverse South African learners. Authors such as De Beer (2015) argue for the inclusion of IK in the Natural Sciences curriculum based on its affordances in addressing affective outcomes, such as an interest in science.

## Our intervention: Short learning programmes for Natural Sciences teachers, addressing the constructs encompassed in the conceptual framework

The three-day SLP was developed with a number of goals in mind, and ensuring that the constructs discussed in paragraph 3 underpin the teaching and learning:

- The SLP should promote SDL among teachers. Therefore, teachers should identify personal learning goals for themselves during the SLP, and identify suitable learning resources to assist them during their learning journeys.
- Indigenous knowledge should be incorporated in a way that is aligned to the syntactical nature of science, and building on the tenets of science. During the SLPs, holders of IK, and not only the teacher educators, engaged with teachers. This was done to ensure the authenticity of the IK.
- Active learning approaches within a CL environment, such as inquiry learning, PBL and CL, should be promoted.
- Teachers should afterwards submit a portfolio, in which they provide evidence of transfer of knowledge and skills to the classroom. They need to critically reflect on their own professional development.

When we developed the SLP, we were faced with a decision on which of the following three perspectives related to IK (Taylor & Cameron 2016; Zinyeka, Onwu & Braun 2016) we wanted to follow:

- The inclusive perspective, which considers IK as part of the natural sciences. This perspective however does not adequately distinguish between the different tenets, respectively, of science and IK. Whereas the natural sciences and IK share many characteristics (e.g. both are empirical and inferential) (Cronje 2015), there are differences too; for example, IK is holistic, in contrast to the reductionist nature of science (Steenkamp, De Beer & Petersen 2019).
- The exclusive perspective, which sees the natural sciences and IK as different (and independent) knowledge domains. One of the predominant arguments for such an approach include the metaphysical aspects that form part of IK. Exponents of such an approach would argue that the inclusion of IK in the science curriculum could promote pseudoscience (De Beer 2019).
- The third perspective can be described as the ‘intersecting domains’ approach, which acknowledges the differences

between the two knowledge systems, but concentrates on the commonalities between them. This is the approach we eventually decided upon, whereby teachers engaged with IK while utilising the processes of science. For instance, the teachers engaged with laboratory protocols to test whether medicinal plants that are culturally used show any antimicrobial activity.

During the SLP, teachers were expected to set learning goals for their own professional development. In their portfolios they had to reflect on the achievement of these goals. For instance, teachers often struggle with the microbiology procedures such as the Kirby–Bauer protocol (Mitchell & Cater 2000) during the SLP, and it is hoped that teachers would set learning goals to develop the necessary laboratory skills to facilitate such practical work in the school laboratory. We also linked the themes in the SLP to the CAPS curriculum. For instance, teachers were requested to plan inquiry-learning lessons, based on sections in the CAPS.

## ■ Methodology

We used design-based research within an explanatory QUAL-quan mixed-methods research (Creswell 2018), as the strengths of each approach can complement each other (Byrne & Humble 2007). A total of 128 teachers participated. For the purpose of this chapter, we only focus on Natural and Life Sciences teachers who participated in the Polokwane (University of Limpopo) and Namaqua (Calvinia) SLPs. In Calvinia, a total of 53 teachers participated, and in Polokwane 75 teachers completed the SLP. The differences between the two SLPs as two different cycles of this design-based research are indicated in Table 7.1. In this design-based research, CHAT was used after each cycle of interventions to analyse the data obtained.

Data were obtained through individual interviews with a sample of teachers prior to and after the intervention, as well as through

**TABLE 7.1:** The differences between the short learning programmes presented in Polokwane (Limpopo) and Calvinia (Namaqua, Northern Cape).

| Differences | Polokwane (Limpopo) | Calvinia (Northern Cape) |
|---|---|---|
| Cycle | Cycle One, 2016; this was our first SLP. | Cycle Two, 2017/2018; based on our insights during Cycle 1, certain changes were made to the SLP. |
| Structure of SLP | Three-day SLP; on Day 1 teachers engaged with holders of IK at the Bakone Malapa Museum. The other 2 days focused on problem-based (PBL) and CL strategies to incorporate IK and foster SDL. | Indigenous knowledge holders participated in the SLP itself (no museum visit, in order to spend more time on PBL and CL activities); multiple learning opportunities (SLP and follow-up workshops); stronger focus on reflective practice and classroom action research. |
| Profile of teachers | The diversity in Limpopo classrooms was reflected in the cohort of teachers, who were of Bapedi, Batswana and Vhavenda descent. The teachers also varied greatly in terms of knowledge and skills – some were seasoned and well-qualified teachers, and others were under-qualified. | A more homogeneous group of teachers, in terms of language (all Afrikaans speaking). Culturally teachers were either Afrikaners, or descendants of Khoi-San cultures. |
| Focus of SLP | General IK knowledge. Teachers were encouraged during the intervention to develop their own teaching and learning resources, making use of cheap, recyclable materials. | Context-specific IK knowledge. Incorporate the IK context from the Northern Cape, notably Khoi-San indigenous knowledge.<br><br>Teachers were encouraged during the intervention to develop their own teaching and learning resources, making use of cheap, recyclable materials. |

SLP, short learning programme; SDL, self-directed learning; IK, indigenous knowledge.

open-ended questionnaires after each intervention. Lesson observations six weeks after the SLP intervention, using the Reformed Teaching Observation Protocol (Sawada, Piburn & Judson 2002) and an analysis of portfolios submitted by teachers six weeks after the intervention were also used to determine the sustained effect after the SLP intervention in classrooms. We also used the views-on-the-nature-of-indigenous-knowledge instrument (VNOIK) proposed by Cronje, De Beer and Ankiewicz (2015) to determine teachers' views of IK before and after the SLP intervention.

For the analysis of qualitative data, coding was done according to the technique described by Saldaña (2009). According to Saldaña (2009:3), a 'code (is) a word or short phrase that symbolically assigns a summative, salient, essence-capturing name for a portion of language-based or visual data'. We applied open coding, while analysing the transcribed interviews, open-ended questionnaires, portfolios and notes on lesson observations. From the different codes emerging themes were identified.

For quantitative data analysis, the VNOIK instrument was analysed using the technique described by Cronje et al. (2015:328). A rubric was used to code teachers' responses as an informed view, a partially informed view or an uninformed view. A numeric value was allocated to each category, with a score of 0 given for an uninformed view, a score of 1 indicating a partially informed view and an informed view earning 2 points. In order to obtain a summative description for each SLP, the mean scores were calculated.

## ■ Cultural-Historical Activity Theory as a research lens

Cultural-Historical Activity Theory was used as a research lens. We concur with Engeström's (2009:24) opinion that 'in today's interconnected world, it is often useful to take two interdependent activity systems as the minimal unit of analysis'. We juxtapose two sets of activity systems in this chapter:

- The contradiction of control between the intended and realised curriculum (comparing the SLP as an activity system, with the post-intervention classroom as second activity system), for each of the two cycles in the design-based research reported on in this chapter.
- A focus on an exceptional case, where most of the intended outcomes were realised in the post-intervention classroom.

Our discussion of CHAT will focus on its utility value as a research lens in:

- Design-based research, where insights into a particular cycle could materialise in design principles informing the next cycle.
- Elucidating tensions in activity systems that could, in the context of this research, reveal design flaws of the SLP, as well as external factors that have an impact on transformed teaching practice.
- Influencing future SLPs, because of its predictive value.

Seaman (2008:5) highlights a number of key methodological characteristics of CHAT as a research lens, such as:

- It provides insight into the human mind in its cultural and historical context.
- CHAT is generally seen as a conceptual system with a number of basic principles, such as the 'hierarchical structure of the activity, object-orientedness, internalisation or externalisation; (and) tool mediation' (Seaman 2008:5).
- It establishes a psychology that concentrates on the interface between the individual, systems or artefacts and other individuals in institutional settings that are historically developing, rather than merely looking at the individual.
- It is 'a non-dualistic approach to understanding and transforming human life that takes dialectical human activity as its ontology' (Seaman 2008:5).

Cultural-Historical Activity Theory is a useful lens in this specific context, as it provides a critical gaze into a complex activity system. Science teachers were traditionally trained in mainstream (European) perspectives on the natural sciences, an in this intervention and research, they had to navigate the complex chasm between western and IK systems. Cultural-Historical Activity Theory provides insight into factors that either enhance or inhibit the realisation of the activity system's object (in this case, their SDL to better facilitate such epistemological border-crossing in the classroom).

# Results

Eight themes emerged from the data, and these are organised in terms of time:

- those themes that emerged from pre-intervention data
- themes that emerged immediately after the intervention
- themes that emerged 6–8 weeks after the SLP.

## Themes that emerged from pre-intervention data

Two themes emerged from the pre-intervention data, namely teachers' naïve understandings and their lack of skills to facilitate true inquiry learning in the science classroom.

### Theme 1: Teachers have naïve understandings and misconceptions regarding problem-based learning, cooperative learning, inquiry learning, indigenous knowledge and self-directed learning

Regarding CL, in the pre-intervention interviews and questionnaires, almost 60% of the teachers indicated that they are aware of CL, and that they viewed it as group work. Teachers made comments such as:

> 'Cooperative learning is a learning strategy that includes small groups of learners, each with a topic, participate and are able to give feedback'. (Teacher F, undisclosed gender, date unknown)
>
> 'Cooperative learning is where the learners participate in the classroom and work together to formulate ideas about the topic discussed in the classroom. The teacher is the facilitator of the lesson'. (Teacher C, undisclosed gender, date unknown; also published in Jacobs, 2018:128).[7]

7. Also reported in the MEd study of Jacobs (2018:128).

Another teacher states that CL is 'very familiar, but I know it as group work'. From the data, it is clear that teachers generally held naïve understandings of the elements that characterise CL, as no reference was made to positive interdependence among group members, promotive face-to-face interaction, individual accountability, interpersonal small-group skills, or group processing, the elements of CL identified by Johnson and Johnson (2009).

The same applies to inquiry learning. To the question, 'How do you understand inquiry learning?', teachers provided responses such as 'I do not know what inquiry learning is', and 'I think it means that you as teacher should not use the chalkboard or textbooks'. Once again, very little reference was made to essential tenets of inquiry learning, such as that there should be a driving question or problem that should be solved, and that learners should engage in the processes of problem solving (Krajcik & Shin 2014).

Teachers also had naïve understandings of IK prior to the intervention. Responses from teachers on what IK entails included 'I just teach theory from textbooks. I do not know what indigenous knowledge is' (De Villiers, De Beer & Golightly 2016:509), and 'At the beginning, I had a misconception that IK means witchcraft and muthi' (De Villiers et al. 2016:509).

A similar trend was seen regarding PBL. One of the teachers commented that:

> 'I so often hear at cluster meetings of problem-based learning, and how important it is in science, but I must be honest and declare that I do not know how to facilitate problem-based learning in my classroom.' (Teacher J, undisclosed gender and age, date unknown).

Self-directed learning was also a construct that teachers could not describe well. Some of the responses included, 'I do not know what self-directed learning is', and 'I need to take responsibility for my students' learning. I therefore need to ensure that they achieve the specific aims.' The latter statement goes against the very nature of SDL, and it was surprising that the majority of teachers felt that students' learning depends on them as teachers – for example, 'I am the architect of my learners' learning. There is a big responsibility on my shoulders to ensure that the learners understand the work.'

### Theme 2: Teachers have a lack of skills in terms of laboratory work (and the tenets of science), and engaging pedagogies

Science education literature shows that many science classrooms are characterised by transmission-mode teaching and learning, and that learners are often not provided with the understandings of the tenets of science that practical work can provide (De Villiers 2018; Motambatamba 2018). This was also the trend when we analysed the pre-intervention data in this study. Several teachers indicated that they are ill-equipped to facilitate practical work in the science classroom. Teacher responses included, 'I was not trained in using lab equipment during my studies. I am too anxious to engage my learners in microscopy, as I do not know how a microscope works', and 'I struggle to assist my learners to plan experiments where they have to provide hypotheses, or identify the dependent and independent variables'. This is probably one of the reasons why teachers adopt 'chalk-and-talk' approaches. Teacher responses include 'lecturing to the learners, and providing them with summaries, is the best way to prepare them for the examination', and 'by allowing learners to copy my notes on the overhead projector, I can ensure that they are better prepared for the examination'.

## Themes emerging directly after the short learning programme

Two themes emerged directly after the SLP. Data were obtained from post-intervention questionnaires, personal interviews with the teachers and observations during the SLP.

## Theme 3: Affective outcomes were achieved during the short learning programme

Teachers were energised by the content of the SLP, and enjoyed the CL, inquiry learning, PBL and IK activities. Comments by the teachers included 'this SLP provided new wind in my sails, and a fresh outlook on teaching and learning', and 'I am inspired, and I would like to try all these methods in my own classroom'.

## Theme 4: Teachers indicated improved understandings of cooperative learning, inquiry learning, problem-based learning, indigenous knowledge and self-directed learning

The engagement during the SLP with CL, inquiry learning, PBL and IK, assisted teachers to develop more nuanced understandings of these constructs. Feedback by teachers on CL included:

> 'After the course, I clearly understand that cooperative learning involves different teaching methods such as the jigsaw method and De Bono's hats method. At first I did not know what it was, but now I understand it'. (Teacher B, undisclosed age and gender, date unknown)

Another example of teacher feedback on CL was that 'I now understand that cooperative learning involves more than just group work, and that learners should have roles, and should individually take responsibility for the learning task' (Jacobs, De Beer & Petersen 2016:543). Sixty per cent of the teachers in Limpopo indicated that the SLP played a major role in changing their views of CL.

Teachers also indicated that the SLP assisted them in understanding the value of inquiry learning. Responses from the teachers include, 'I have learnt that problems from learners' environments will enhance learning' (Teacher, undisclosed gender and age, date unknown), and:

> 'I was so excited to do the Kirby–Bauer practical work, and to determine if the plant chemicals can kill bacteria. It made me wonder if my learners experience the same excitement in my classroom. I will definitely engage them in inquiry learning in future'. (Teacher P3, undisclosed gender and age, date unknown)

Another comment by a teacher was, 'I will use problem-based learning as it gives learners independence and it is more fun when you learn something on your own' (De Villiers et al. 2016:512).

In Table 7.2 we indicate how the SLP facilitated a better understanding of IK as obtained from the VNOIK instrument.

As can be seen in Table 7.2, there was an increase of 28.5% in teachers holding informed views of *IK* after the SLP (an increase from 17% in the pre-intervention data, to 45.5% in the post-intervention data).

The SLP was intended to enhance SDL, and it was heartening to see that teachers became more aware of the importance of identifying their own learning needs and obtaining their own learning resources. One teacher commented:

> 'I felt quite lost during the Kirby–Bauer laboratory work that we have done. I realised that I will have to learn how to incorporate such practical work in my lessons. One of my colleagues at a neighbouring school holds a science honours degree, and I will have to consult this colleague for assistance'. (Teacher K, undisclosed age and gender, date unknown)

**TABLE 7.2:** Teachers' views of IK, prior to and after the short learning programme.

| View of IK | % Pre-intervention | % Post-intervention |
|---|---|---|
| Uninformed view | 4.5% | 0% |
| Partially informed view | 78.5% | 54.5% |
| Informed view | 17% | 45.5% |

*Source*: Petersen, Golightly and Dudu (2019:174).

## Themes that emerged from the data 6–8 weeks after the short learning programme

Participating teachers had to submit portfolios 6 weeks after the SLP, in order to receive certificates. These portfolios were analysed, and classroom observations were also conducted for selected teachers in both Limpopo and the Northern Cape. Personal interviews were also conducted with a number of teachers.

### Theme 5: There is a general lack of transfer of knowledge and skills in the classroom

The general lack of transfer of newly acquired knowledge and skills after the SLP in the classroom was especially true of the Limpopo SLP. In the case of the Northern Cape intervention, there were more examples where transfer did take place. However, the general trend was that teachers reverted to their predominant pedagogical orientations, such as direct instruction.

Table 7.3 shows the different codes under this theme, as well as context of the lessons (either observed during school visits, or provided in the portfolios submitted). This might provide insight into the lack of transfer of newly acquired knowledge and skills to the classroom.

Of course, there were also a few exceptions, where teachers provided evidence of good transfer of knowledge and skills in the classroom after the SLP. One such example is provided in Table 7.4, where a teacher infused IK in a creative way into the curriculum theme ‘DNA technology’, although evidence of active teaching–learning strategies is not clearly indicated.

### Theme 6: Habits of mind, lack of agency and lack of self-directed learning leads to the ‘wash-out’ effect

Despite teachers’ enthusiasm during the SLP, it was disappointing to note the lack of transfer of new knowledge and skills to the

**TABLE 7.3:** Codes under the theme 'lack of transfer of knowledge and skills in the classroom'.

| Code | Description of lesson(s) (either observed lesson, or lesson plan in portfolio) |
|---|---|
| Poor attempt at infusing IK in lesson | In general, teachers paid 'lip-service' to IK. Many lessons did not include any reference to IK, and where it was included, it was mostly done by referring to a few examples (notably medicinal plants such as devil's claw, African potato and *Hoodia* [referred to in the CAPS Life Sciences curriculum (Department of Basic Education 2011b:52)]). Little attention was paid to the syntactical nature of the subject, or to highlighting the shared tenets of science and IK. One of the Limpopo teachers included a lesson plan where learners had to test the antimicrobial activity of *muthi* plants (based on the Kirby–Bauer technique implemented during the SLP), and although this attempt at such epistemological border-crossing should be welcomed, the lesson plan provided evidence of the teacher's continued engagement with recipe-type approaches to laboratory work. Instead of structuring the learning opportunity as an open enquiry learning task, the teacher reverted to cook book recipes in which she also demonstrated a lack of knowledge on laboratory protocols. Below is an excerpt from the teacher's lesson plan:<br>· Pump organisms in the plate.<br>· Sterilize hockey stick with 95% ethanol.<br>· Flame hockey stick.<br>· Take antibiotic discs and out them inside the plant sample.<br>· Incubate with 37 degrees.<br>The lack of scientific terminology is a concern. 'Pump organisms' refers to 'inoculate microbes', and the 'hockey stick' refers to the inoculation needles used in microbiology labs. How a teacher with such poor competency in the syntactical nature of the natural sciences could successfully portray the tenets of science in the classroom, is a concern. |
| Poor attempt at utilising CL strategies | Despite teachers' enthusiasm during the SLP of engaging in CL strategies such as De Bono's thinking hats and the jigsaw method, the post-intervention lessons provided very few examples of true CL. The excerpt from a lesson plan below characterises many of the lessons in the post-intervention phase, where group work is used as synonym for CL:<br>Grade 7 Natural Sciences<br>Topic: Plants are useful to people<br>Introduction: **I will explain** to the learners that plants are useful to people, e.g. as food and beverages, as medicine, as soaps and cosmetics, and for its use in weaving and basketry.<br>Group work: I will assign learners to small groups of six. I will instruct them to study pages 28–29 in their textbooks, and to discuss the use of plants by people.<br>Assessment: I will call on individual learners, and ask them questions such as: |

Table 7.3 continues on the next page→

**TABLE 7.3 (Continues...):** Codes under the theme 'lack of transfer of knowledge and skills in the classroom'.

| Code | Description of lesson(s) (either observed lesson, or lesson plan in portfolio) |
|---|---|
| Poor attempt at utilising CL strategies | · Which plant is commonly used as a laxative?<br>· Give an example of a plant commonly used for making soap?<br>This lesson demonstrates the teacher's dependency on the textbook (in this particular case, the *Via Afrika Natural Sciences Grade 7 Learner's Book*). This could have been a lovely topic for learners to investigate, and group members could have conducted desktop research on the various categories of plant use, for example, one learner could have studied African beer making practices such as by using sorghum, another learner could have researched the use of plants as medicine (about 4000 plant species are used as medicines in South Africa), while another member of the group could have focused on saponification and traditional soap making. Unfortunately, little evidence was provided for the elements of CL, that is, positive interdependence among group members, constructive face-to-face interaction, individual accountability, interpersonal small-group skills and group processing.(Johnson & Johnson 1996:786) |
| Little evidence of inquiry learning | The majority of lessons were still characterised by transmission-mode ('chalk-and-talk') approaches. Where laboratory work was included, it was mostly 'recipe' type activities, where learners were engaged in 'cookbook' activities, following instructions, but with little cognitive engagement. A typical example is the lesson plan below:<br>Natural Sciences Grade 8<br>Topic: Photosynthesis<br>Instructions:<br>· Take a leaf and put it in a beaker of boiling water to kill the cells. You will notice a slight colour change.<br>· Using tongs, remove the leaf and place it in a test tube containing methylated spirits. This advances the removal of chlorophyll, and now you will notice a more intense colour change.<br>· Place the test tube in a beaker with water, and let it boil for a few minutes.<br>· Let it cool off, and then take the leaf out and place it on a white tile. Note the green colouring in the test tube. The methylated spirits has speeded up the process of removing the green chlorophyll from the leaf.<br>· Add a few drops of iodine solution to the leaf.<br>· Note the colour change. If it turns blue-black, starch is present.<br>The above experimental procedure in the teacher's lesson plan has been taken from the *Via Afrika Natural Sciences Grade 8 text book* (De Beer et al. 2013). Two observations are that (1) teachers are very dependent on textbooks, and (2) very little inquiry learning is evident in this example. |

Table 7.3 continues on the next page→

**TABLE 7.3 (Continues…):** Codes under the theme 'lack of transfer of knowledge and skills in the classroom'.

| Code | Description of lesson(s) (either observed lesson, or lesson plan in portfolio) |
|---|---|
| Little evidence of inquiry learning | An ideal approach would have been to engage learners in open-ended inquiry (e.g. plan an experiment to test whether energy is stored in the form of starch in the leaf). Furthermore, instead of drawing on learners' observations, and prompting them to provide explanations for their observations, the teacher's instructions provide the answers to the learners. For example, 'Note the green colouring in the test tube. The methylated spirits has speeded up the process of removing the green chlorophyll from the leaf', could have been formulated better, and learners could have been asked 'What role did methylated spirits play in this investigation?' |
| Little evidence of fostering SDL in the classroom | A general trend in the lesson plans provided is that teachers view their primary task as preparing learners for the examination, and to 'teach to the test'. The following exemplar is typical of the lessons provided in the portfolios:<br><br>Grade 10 Life Sciences<br><br>Topic: Terrestrial biomes<br><br>Introduction: I will ask learners what biomes are.<br><br>Lesson: I will explain each of the following biomes to the learners: savannah, grassland, Nama Karoo, succulent Karoo, fynbos and forest biome.<br><br>Learner activity: I have summarised the main elements of each of the different biomes on transparencies, and learners will copy my notes in their workbooks. This will ensure that they will know the main characteristics of each biome in the examination.<br><br>Biomes is a very interesting topic in the Grade 10 Life Sciences curriculum, and the teacher could have packaged this topic in a way to enhance SDL. For example, learners could have been asked to develop eco-tourism guides for various regions in the country, as this would have sparked individual research where learners had to find relevant learning resources, identify the key elements of each of the domains and also consider the eco-tourism potential of each biome. |
| A lack of creativity, and a dependence on textbooks and support material provided by the Department of Basic Education | It was conspicuous how many of the teachers' lesson plans were taken from textbooks, or from support material provided by the Department of Basic Education (such as its Thutong portal, or the *Mind the Gap* study guides). At times the lesson plans, at first glance, appeared to provide evidence of innovation and creativity, until we realised that they came from textbooks. The example below (from a submitted portfolio) is a hands-on activity to demonstrate natural selection. However, when this particular teacher was observed teaching natural selection, she presented a lecture in which she dealt with Darwin's construct of natural selection in a factual manner, with no learner engagement whatsoever. This also made us realise that the lesson plans provided in the portfolios is by no means a good barometer of the teaching that takes place in the classroom.<br><br>**Activity: Natural selection, evolution and extinction**<br><br>**What learners will need:** |

Table 7.3 continues on the next page→

**TABLE 7.3 (Continues...):** Codes under the theme 'lack of transfer of knowledge and skills in the classroom'.

<table>
<tr><th>Code</th><th>Description of lesson(s) (either observed lesson, or lesson plan in portfolio)</th></tr>
<tr><td>A lack of creativity, and a dependence on textbooks and support material provided by the Department of Basic Education</td><td>Pliers of different shapes, tweezers, washing pegs, pegs used to seal plastic bags; barbeque tongs; marbles; various shapes of macaroni and pasta (amongst others, shell-shape pasta); different seeds; dry beans.<br><br>What learners will do:<br>· In this activity the various pliers/ tongs/ tweezers/ pegs represent different bird beaks. The marbles, seeds and pasta represent different sources of food.<br>· Each learner in the group gets one of the pliers/ tongs/ tweezers/ pegs.<br>Mix all the food (marbles, pasta, different seeds, dry beans), and put it in the middle of the table.<br>· Give a signal, and during a time period of 1 min, each learner needs to grab as much food as possible with his/her pliers/peg (beak).<br>· At the end of the minute, every learner should count the number of food items that the 'bird' could eat in the 1 min.<br>· Also work out the energy value of the food, using the following formula:<br>Marble = 10 kJ energy<br>Pasta = 4 kJ energy<br>Bean = 3 kJ energy<br>Other seed = 1 kJ energy<br>· In order to survive, a bird needs 20 kJ of energy. All birds that ate less than this will become extinct.<br>· In order to reproduce, the bird needs to consume at least 30 kJ of energy. Determine how many birds were able to reproduce. What would happen to birds that couldn't reproduce?<br><br>Questions<br>1. Are all 'beaks' equally successful in feeding? Explain.<br>2. What are the reasons that organisms become extinct?<br><br>The above example was copied by the teacher from the Via Afrika Life Sciences Grade 12 book (Bowie et al. 2014). Despite the fact that this teacher understood the value of a learner-centred activity as provided in her lesson plan as part of her portfolio, she reverted to 'chalk-and-talk' approaches, when we observed her lesson in the classroom.</td></tr>
</table>

*Source*: This table is the authors' own creation, based on four years of design-based research. It provides excerpts from teachers' lessons plans. The last lesson plan was copied by the teacher from a Via Afrika school textbook (Bowie et al, 2014), which is acknowledged in the references.
CAPS, Curriculum and Assessment Policy Statement; CL, cooperative learning; Indigenous Knowledge; SDL, self-directed learning; SLP, short learning programme.

**TABLE 7.4:** One of the exceptional lesson plans, providing evidence of classroom transfer.

| Teacher activities | Learner activities |
|---|---|
| I will ask learners to provide examples of how DNA technology finds application in our everyday lives. | Learners will discuss DNA technology in small groups, and will Google information on their cell phones. |
| Consolidation of learners' feedback: Applications of DNA technology (e.g. DNA Barcoding) – for example, authentication of medicinal products, and wildlife crime. | A question-and-answer session, where learners will discuss applications of DNA Barcoding in combating rhino pouching. |
| Contextualisation of the lab activity: A few cases were reported of patients who died when they took medicines provided by traditional healers. It is therefore necessary to determine which plant and animal materials were used in the medicines. | Learners are guided in realising that DNA could provide the key to solve this problem. |
| Lab: Extracting DNA from bananas. | Learners engage in practical work in the laboratory, extracting DNA from bananas. |
| Reporting on the investigation: learners will be asked to report on the findings in the form of either a lab report, or a journal article. | Learners study examples of journal articles, and they then, in small groups, plan and write an article. |

*Source*: This is our own construction, of the lesson plan of one of the teachers (research participant P5, undisclosed age and gender, date unknown).
DNA, Deoxyribonucleic acid.

classroom after the intervention. In this regard, Warford (2011:255) speaks of 'discarding the academy for what teachers perceive as the real world of teaching'. In similar context, Zeichner and Tabachnick (1981:7) refer to the 'wash-out' effect, which describes the phenomenon that many teachers revert back to previous teaching habits, and that they do not seem to be able to address systemic challenges. Comments by teachers in the post-intervention interviews include: 'I do not have a classroom lab or equipment, and therefore cannot do practical work', and 'Although we have learnt about IK in the course, I still do not have enough knowledge to teach it'. In the three-day SLP we attempted to make teachers aware of the affordances of IK in the science classroom, and it was hoped that teachers would, as self-directed learners, set goals for their own further learning on IK systems. However, the post-intervention interviews gave the impression that teachers expected to be 'taught' everything they needed to know to incorporate IK in the teaching of science curriculum themes. A major emphasis was placed on teachers exploring the concept of 'frugal science' (Jackson, De Beer & White 2018) during the SLP. Jackson et al. (2018:217) describe frugal science as the introduction of 'cheap, accessible scientific educational tools within developing countries'. Although teachers were encouraged during the intervention to develop their own teaching and learning resources, making use of cheap, recyclable materials, little evidence of such agency was provided in the post-intervention data.

## ☐ Theme 7: Teachers indicated that the performance-driven education system influences their teaching practice

During the post-intervention interviews, teachers made comments such as, 'Although IK is interesting, it will not help learners to pass the examination. I need to focus on the CAPS content', and 'Practical work and inquiry takes a lot of time, and does not prepare learners for the examination'. Another teacher stated that:

> '[*A*]ll these lofty things like inquiry learning and indigenous knowledge might be attainable in private schools, but if one teaches in a township school, your focus should be on preparing the learners for the examination, so that they will pass'. (Teacher G, undisclosed gender and age, date unknown)

Ramnarain and Schuster's (2014) research has highlighted the fact that teachers' pedagogical orientation in township schools is influenced by the emphasis on examination performance:

> [*The*] generally poor performance in national science examinations of students at township schools had led to a strong teaching focus towards preparing for high-stakes summative examinations. This emphasis on scoring high marks meant that these teachers, although they believed in the notion of student-centredness, felt the need to adopt teaching methods whereby students would assimilate the

> 'products' of science, i.e. the body of required knowledge, and thus be better prepared for these examinations. (p. 648)

Unfortunately, the Department of Basic Education fuels this performance-driven system. If one studies the *Mind the Gap* study guide of the Department of Basic Education (2012), it becomes clear that the department's focus, despite the noble outcomes envisaged in the CAPS document, is to ensure a good pass rate. In the Ministerial Foreword of the *Mind the Gap* study guide, Motshekga (Department of Basic Education 2012:n.p.) writes: 'the series aims to mind the gap between failing and passing, by bridging-the-gap in learners' understanding of commonly tested concepts so candidates can pass'. She (Department of Basic Education 2012) further continues by stating that:

> Each of the *Mind the Gap* study guides provide explanations of key terminology, simple explanations and examples of the types of questions that learners can expect to be asked in an exam. Model answers are included… (n.p.)

The *Mind the Gap* series even provides mnemonic codes for learners to memorise facts (p. xi). One can therefore not only blame teachers for the focus on 'teaching-to-the-test', as this method filters down from the Department of Basic Education.

## ☐ Theme 8: Teachers indicated that the time constraints ('pace setters') negatively influence innovative and learner-centred teaching and learning

Teachers, during the post-intervention interviews, indicated that 'Cooperative learning and inquiry learning takes a lot of time. One can do much more in a lecture.' Another teacher indicated that:

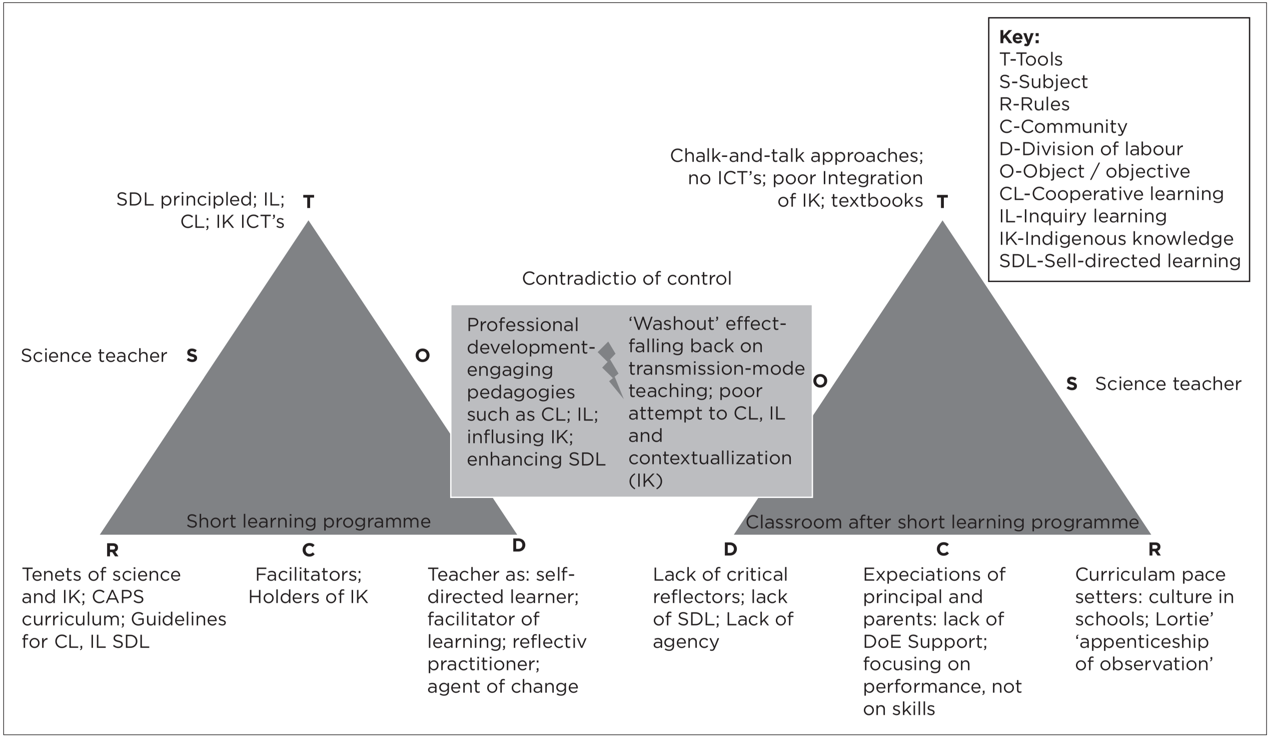
> 'I was so inspired by what we have learnt in the short course, but I am afraid that I will not have enough time to do it in my classroom.

> The test on muthi plants takes a lot of time, and I have to keep to the pace setter'. (Teacher L7, undisclosed gender and age, date unknown)

In similar vein, a teacher commented that 'there is a lot of content, and they (Department of Education) increased it' (Teacher, undisclosed gender and age, date unknown). Ramnarain and Schuster's (2014) research had similar findings, namely that teachers rely on lectures, as they are seen as more time effective, and better in preparing learners for summative assessment opportunities.

## Internal and external tensions in the activity systems, utilising the Cultural-Historical Activity Theory

In this chapter we juxtapose two interdependent activity systems, namely the SLP (the intended curriculum) with the post-intervention science classroom (the enacted curriculum), using CHAT as a research lens, as shown in Figure 7.1. We utilise CHAT on a personal plane (Rogoff 1995), where the subject in both activity systems is the science teacher. The object of the intended curriculum (the SLP) is to assist teachers in their professional development to effectively facilitate CL, inquiry learning, PBL and SDL in the classroom, and to effectively engage in the epistemological border-crossing between natural sciences and IK. For this reason, 'tools' such as engaging pedagogies (the jigsaw method, De Bono's thinking hats, and PBL activities such as the Kirby–Bauer protocol) were utilised during the SLP. The 'rules' in the SLP activity system included the tenets of science (e.g. its empirical and inferential nature), the tenets of IK (like science, IK is also empirical and inferential, but in contrast to science, it is also metaphysical and holistic in nature) (Cronje et al. 2015) and the principles underpinning engaging pedagogies such as cooperative-, inquiry- and problem-based learning. The 'division of labour' focused on the different roles of teachers that the SLP wanted to further develop, such as the teachers' reflective




*Source*: Authors' own creation, utilising Engeström's (1987) third-generation CHAT lens in their own research context.

**FIGURE 7.1:** Cultural-Historical Activity Theory as a research lens showing tensions in the activity systems (the 'intended' curriculum of the SLP and the 'enacted' curriculum in the post-intervention science classroom).

skills, their abilities as self-directed learners and their facilitation skills to engage in complex border-crossing between science and IK. The SLP facilitators and holders of IK formed the 'community' that scaffolded teachers' learning across the Vygotsky's (1978) zone of proximal development.

However, the activity system on the right in Figure 7.1, namely the post-intervention science classroom, shows that a different object (compared to the system on the left) was achieved, therefore the 'contradiction of control' (McNeil 1999). The object in the science classroom as an activity system illustrates the so-called 'wash-out' effect, with the emphasis on transmission-mode teaching, or 'teaching to the test'. A number of tensions that arise in the activity system result in such a 'contradiction of control'. By using CHAT as research lens, various internal and external tensions arise in the activity systems. This is represented in Figure 7.1. The internal tensions refer to tensions that arise in the subject itself — Engeström refers to the 'dynamics of the subject' (Engeström & Glăveanu 2012). Teachers often feel uncomfortable in exposing themselves to new teaching and learning strategies, and often revert back to familiar approaches (such as 'lecture-style' lessons).

Various external tensions arise in the two activity systems. For example, a tension often exists between the 'subject' (teacher) and the 'community'. The Department of Education, parents and principals often hold expectations that might erode inquiry and CL, despite the teachers' pedagogical orientations or professional learning opportunities. One example referred to earlier in this chapter is the emphasis on mnemonic codes, and 'coaching for the examination' in the Department of Education's *Mind the Gap* study guides. There also exist tensions between the 'division of labour' and the 'community'. Reasons why teachers are often not reflective practitioners could also be better understood by looking at the demands placed on a teacher from stakeholders in the activity system, for example, teachers being expected to assist in myriad extramural activities. Teachers also showed a lack of agency in this research. Whereas emphasis was placed on 'frugal science', or so-called 'science-on-a-shoestring' approaches during the SLP, teachers still ascribed the lack of practical investigations in their classrooms to a lack of apparatus and materials.

An important tension that should be noticed is the influence of 'rules' in the activity system on the realisation of the 'object' in the activity system. Despite the emphasis on the tenets of science and IK, and the engagement in the principles underpinning engaging pedagogies during the SLP, little of this is seen in the post-intervention science classroom. The reason is that new 'rules' dictate what happens in the classroom. Firstly, the rigid pace setters discourage teachers from engaging in cooperative- and problem-based learning. (This is also an internal tension in the subject itself, as many teachers hold the misconception that engaging pedagogies are more time-consuming than transmission approaches.) A second 'rule' is the so-called 'apprenticeship of observation' (Lortie 1975). This construct refers to the fact that teachers often hold deeply engrained beliefs about teaching, which they obtained through having had the opportunity to observe their own teachers when they were school pupils. Their own teaching and learning philosophies were thus shaped by the behaviour of other teachers that were observed over a long period of time. Borg (2004:274) describes this disposition as the 'ready-made recipes for action and interpretation that do not require testing or analysis while promising familiar, safe results'. New ideas communicated during teacher professional development interventions therefore are in competition with longstanding beliefs, and therefore we often experience the 'wash-out' effect.

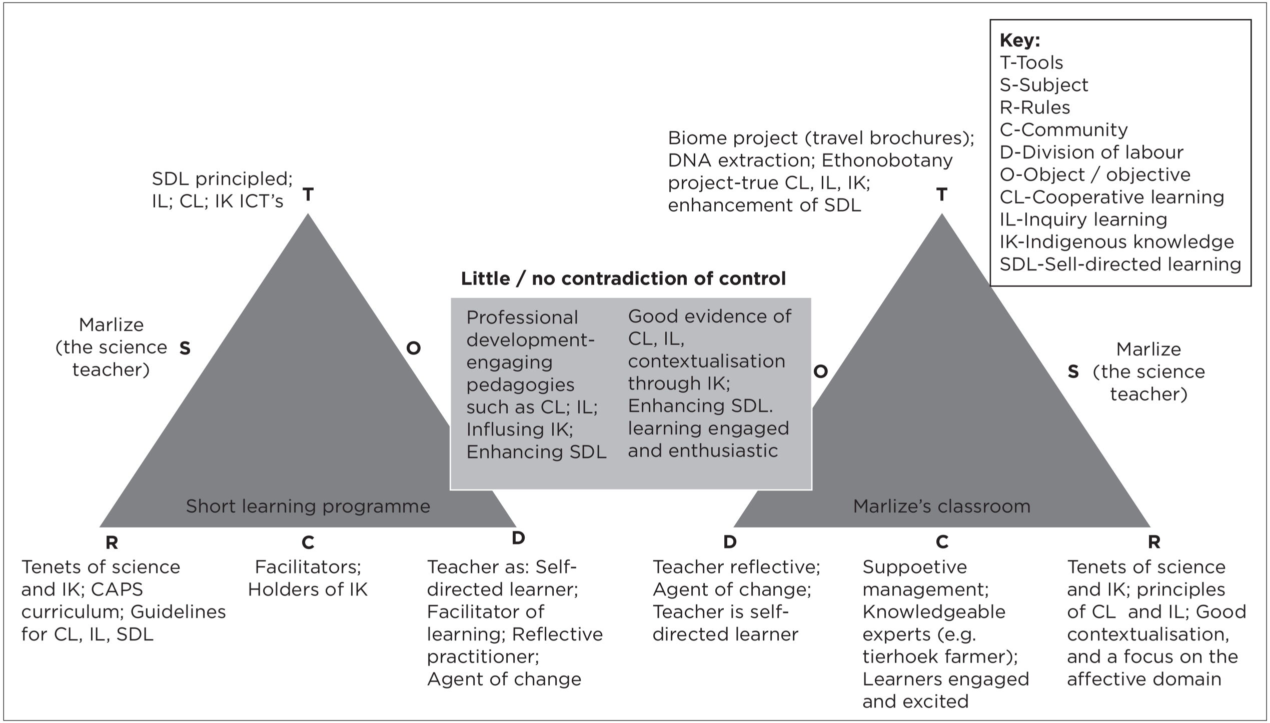
Because of systemic pressures and own beliefs, science teachers often fall back to familiar 'tools' after professional development interventions, and this post-intervention data shows that teachers continued with 'chalk-and-talk' approaches, with poor integration of IK into science lessons.

All these tensions give rise to the ‘contradiction of control’, and the misalignment between the intended and the enacted curriculum.

## Every dark cloud has a silver lining: The exceptions

The previous section portrayed a dark picture of the influence of SLPs on transformed teaching practice. In this research there were the welcomed exceptions also (especially in the second cycle of SLPs, namely in the Northern Cape). One such example is a Calvinia Life Sciences teacher, Marlize. In Figure 7.2 we use CHAT as a research lens to juxtapose the SLP with Marlize’s classroom.

This teacher engaged her learners in learner-centred activities such as an ethnobotanical survey (that fulfilled all the criteria of ProjBL, as stipulated by Krajcik and Shin (2014)), and her lessons were characterised by good contextualisation (in terms of infusing IK into lesson themes), as well as the incorporation of CL and PBL. The ‘rules’ that guided teaching and learning were compliance to the tenets of science and IK, and structuring teaching and learning according to the principles of CL and PBL. Marlize enjoys the privilege of having a supportive community, for example, her principal himself participated in the SLP. She is thus supported in her attempts to use engaging pedagogies in her classroom (rather than to ‘teach-to-the-test’). However, the critical factor that distinguishes Marlize from most of her colleagues lies within the ‘division of labour’ node of the activity system. Marlize is a self-directed learner. When she engaged her learners in the ethnobotanical survey (as ProjBL), she quickly realised that she did not have the necessary botanical knowledge to effectively assist her learners. In Knowles’ (1975) parlance, she therefore identified a learning goal (improving her knowledge on the flora of the Namaqua district), she identified resources to facilitate her learning (a knowledgeable farmer and botanist in




*Source*: Authors' own creation, utilising Engeström's (1987) third-generation CHAT lens in their own research context, and utilising data stemming from the design-based research.

**FIGURE 7.2:** Marlize's classroom, with little 'contradiction of control'.

the area) and she implemented appropriate learning strategies (amongst others, a WhatsApp group to share pictures of flowers, in order to identify them). Marlize also realised how important it is to deliberately teach for the affective domain (see the 'rules' in Figure 7.2). De Beer, Petersen and Brits (2018:173) make the claim that teachers often treat affective outcomes as if it is a 'game of bingo'; hopefully affective outcomes will be achieved, although it is not a deliberate design of the lesson plan. Marlize set as lesson outcome that learners' interest in Life Sciences should be kindled, and that they should come to value the role of science in everyday life. This paid off – in the post-intervention interview she commented that, 'The Grade 10 class is actually a difficult class. It was therefore amazing for me to see how learners participated and were engaged. They were so excited about the project.'

# Conclusion

The chapter concludes by focusing on a number of key considerations.

## Cultural-Historical Activity Theory provides insight into reasons for the misalignment between the intended and enacted curriculum

We concur with Gretschel, Ramugondo and Galvaan (2015), who state that:

> CHAT provides a well-suited lens that recognises that what people do cannot be separated from the influence of context and aspects of power and power relations inherent in the context. CHAT (dialectically) links the individual and the social structures in which they exist, attending to not only the interpersonal and communicative (behaviour) of individuals but also the historical, economic, cultural, political aspects shaping the object oriented-ness of the activity. (p. 4)

A CHAT analysis of the data shows that teachers' pedagogical orientations are influenced by systemic pressures, such as the expectations of the Department of Education, principals and communities that teachers should ‘teach-to-the-test’. These pressures also influence the utilisation of the tools, for example, the expectation to use the prescribed text books. The ‘tools’ utilised in the majority of science classrooms, do not lead to the enhancement of SDL, or to the acquisition of 21st century skills.

## This research provides a number of perspectives that have implications for teacher education – Both pre-service and in-service

Our research shows that in-service teachers generally have poor understandings of the tenets of science and how to foster active learning in the classroom. It is therefore important that, in both pre- and in-service teacher education, teachers should be exposed to the syntactical nature of the subject. Furthermore, teachers are generally ignorant of how IK could be incorporated in the school curriculum to better contextualise science for culturally diverse learners. Many teachers and student teachers are of the opinion that IK constitutes ‘pseudoscience’ (De Beer 2019), and therefore teacher education programmes should focus on the characteristics of both science and pseudoscience.

## Cultural-Historical Activity Theory not only provides a view on tensions in the activity system, but is also used as a tool in assessing the short learning programme

Whereas researchers could easily ascribe the lack of transfer in the classroom to systemic (external) factors, CHAT provides a more nuanced perspective, and also alerts to possible internal factors, such as design flaws within the SLP itself. For example, many teachers hold the misconception that engaging pedagogies such as CL and PBL are more time-consuming than ‘chalk-and-talk’ approaches, yet the SLP did not attempt to debunk this fallacy and could now be rectified.

## Recommendations: Towards fourth-generation Cultural-Historical Activity Theory

Cultural-Historical Activity Theory as a research lens can provide the researcher with deeper insight into the data, and the complexity of the 'object' in an activity system can be better understood by looking at 'rules', 'division of labour' and 'tools' more closely. It can highlight both external and internal factors that impact the object of the activity system. Cultural-Historical Activity Theory as a lens further has predictive value. If this SLP were to be offered in KwaZulu-Natal, the insights obtained from the Limpopo and Northern Cape interventions could assist the facilitators in preventing many possible pitfalls.

Whereas this chapter had the goal to show the utility value of third-generation CHAT as a research lens, Mentz and De Beer (2019) argue for engagement in 'change laboratories' and utilising fourth-generation CHAT as a research lens to address the contradiction of control obtained through this research. In Figure 7.1, the 'contradiction of control' was illustrated, and this stems from the fact that the different stakeholders in the activity system (e.g. the Department of Education, teachers, principals, parents and HEIs, amongst others), all held different views of the 'object' of the activity system. Mentz and De Beer (2019:252) argue that 'change laboratories provide a space where all stakeholders engage in expansive learning, and attempt to come to a shared understanding of the object'. These researchers argue for a shift 'to fourth-generation CHAT, where all stakeholders are seen as different activity systems' (p. 252), and where researchers can come to a better understanding of how the 'contradiction of control' could be reduced. Such fourth-generation CHAT is illustrated in Figure 7.2. This highlights the versatility of CHAT as a research lens. It is recommended that future professional development interventions should take note of the results obtained through third-generation CHAT and consideration should be given to fourth-generation CHAT to incorporate all stakeholders into this problem space. Patton et al. (2015:2) agree, and state that 'to be effective, teacher professional development needs the guidance, support, and leadership of subject matter coordinators, (school principals), (district) curriculum coordinators'.

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Chapter 8

# Facilitator experiences on implementing technology-supported cooperative learning professional development

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## Abstract

Achievement in Mathematics is always a topic that draws a lot of attention, especially in South Africa. One way in which to support teachers in successfully implementing the curriculum and improving their teaching practice is to assist them in becoming more self-directed. Cooperative learning is a strategy that has been connected to the promotion of SDL. This chapter reports on the experiences of a facilitator who has implemented a Technology-supported Cooperative Learning Professional Development (TSCL PD) programme for in-service Mathematics teachers with the aim of promoting their SDL skills and also increasing their mathematical pedagogical content knowledge. Framed within the interpretive paradigm, a qualitative approach was followed. The facilitator was the only primary participant in this self-study project. The facilitator noted that the teachers enjoyed the practical professional development sessions and found these sessions to be a value addition. He also noticed that the teachers seemed to indicate a stronger sense of ownership for their own learning processes. The facilitator's reflection process offered valuable insights with regard to presenting TSCL PD to promote teachers' SDL skills.


**Keywords:** Technology-supported cooperative learning; Professional development; Self-directed learning; Cooperative learning; Mathematics Education.

## Introduction

Different reports – for example the National Education Evaluation and Development Unit and the National Report on the Annual National Assessments (DBE 2012) indicate that learners perform ineffectively in both the TIMSS (see Reddy et al. 2016) and the Annual National Assessment (ANA). These reports show that learners in South Africa perform 'below acceptable levels in reading, writing and counting' (DBE 2011:6, 2012). Evidence in support of this position, can be found in the work of the Centre for Development and Enterprise (CDE 2013:3), as they also posit that the way in which Mathematics is taught in South Africa, is 'amongst the worst in the world as teachers themselves struggle to respond to questions that they are teaching from the curriculum and expecting their learners to answer'. From these results, there is a realisation that teachers are responsible for deciding how Mathematics should be taught and learnt. As a result, teachers have a significant impact on the learners' academic performance and achievements.

This chapter reports on the experiences of a facilitator who has implemented TSCL PD with primary school Mathematics teachers, in order to help them stay up to date with content knowledge and move towards teaching and learning that equips learners with the necessary skills to cope in the 21st century. Seven teachers from different primary schools, who attend PD workshops once a week at the Royal Bafokeng Institute in the Rustenburg area, were observed, during the implementation of TSCL PD. The research question that thus guided this investigation was: 'how does a facilitator experience the implementation of technology-supported cooperative learning professional development?'.

## ■ Problem statement

Fauzan, Plomp and Gravemeijer (2013:161) reveal that *poor quality teachers as well as poor teaching* practices are the reason for the crisis in Mathematics education in South Africa. They posit that *the causes* of *poor* learner *performance* in Mathematics might be impacted by different aspects, for example, outdated teaching practices, changes in the curriculum and teachers' lack of adequate content knowledge of the subject. Wagner (2011:4) suggests that in order to promote learners' conceptual understanding, it is important that teachers themselves (as learners), firstly need to develop into 'self-directed individuals', in order to cope with changes, stay up to date with content knowledge and move towards teaching and learning that fosters SDL in their classes.

Another factor that may affect the poor performance in Mathematics Education [and teachers' lack of SDL], is the training that the teachers received (Rakumako & Laugksch 2010:139). It has been established that conventional approaches to professional development (PD) such as one-time workshops usually do not lead to noteworthy changes in teaching methodologies (Murtaza 2010:123). Research demonstrates that PD strategies such as seminars, conferences and sit-and-get or one-time-only PD have minimum impact on the continuing PD for teachers (Guskey & Yoon 2009:496; Murtaza 2010:123). These PD strategies do not help teachers take responsibility for their own professional growth (i.e. become more self-directed). Although much research can be found related to the experiences of the teachers participating in the PD initiatives, little information is available regarding the experiences of the facilitators who design and present these PD initiatives. In light of this, this chapter reports on the experiences of a facilitator who designed and implemented a TSCL PD initiative with in-service teachers to attempt to promote these teachers' SDL skills as well as their pedagogical content knowledge.

# Literature review

In order to answer the set research question that guided this research, a sound overview of the body of scholarship regarding the main aspects of this investigation needs to be provided.

## Self-directed learning

A number of studies have established SDL as an essential life skill that supports lifelong learning (Guglielmino 2008:1; Knowles 1975:15; Mok & Lung 2005:34). The idea that teachers should take accountability in the process of lifelong learning is based on Knowles' (1975) adult learning theory (i.e. SDL). Knowles (1975) defines SDL as a process:

> [/]n which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing learning strategies, and evaluating learning outcomes. (p. 18)

Merriam and Brockett (2007:137) on the other hand define SDL as an involvement of 'adults assuming control of their learning'. From the two definitions above, it is clear that SDL is more focused on the control that individuals have over their learning. Self-directed learning is a process which offers an individual (in the case of this investigation, the teacher participating in the TSCL PD) the opportunity to set goals, plan, evaluate and implement their own learning (Thornton 2010:181).

## ☐ Characteristics of a self-directed learner

The characteristics needed by learners (teachers in the case of this study) to be lifelong learners are:

1. finding joy in learning
2. being motivated to learn
3. seeing change as a challenge rather than an obstacle
4. seeing solutions to problems through continuous learning
5. being able to select and use different learning strategies (Guglielmino 2013:3).

The characteristics of SDL, as stipulated by Guglielmino (2008:2), embrace having the option to search for new information and combining such information with existing information. This implies that teachers who are self-directed, ought to have the option to link the information and apply it to new situations. These teachers are able to receive information, analyse it and use it to their benefit, as well as the benefit of their learners. According to Guglielmino (2013:3), these teachers should also be able to set learning goals, and implement and evaluate their learning process (Guglielmino 2013:3).

## The need for teachers to develop self-directed learning

Guglielmino and Long (2011:1) contend that the complexity and rate at which our world is changing influences our day-to-day existence, and requires lifelong SDL. It is therefore important that teachers keep up with the changes, by enhancing their self-directedness and making sure they are able to meet the 21st century requirements, especially with regard to curriculum practice (Verster et al. 2018:2825). It is through SDL that teachers can be responsible for their own self-development and improve their teaching methodologies (Wagner 2011:2). Thornton (2010:160) expresses a similar view, namely that teachers who are self-directed are able to create a classroom culture that engages learners in creative and critical thinking activities.

The opinion of Verster et al. (2018:2825) is that SDL is an opportunity for teachers' professional growth, where teachers take responsibility by equipping themselves in order to succeed in the fast-changing environment. In support of this argument, Thornton (2010:161) makes it clear that SDL could prove to have a strong impact on how teachers make decisions about their learning goals as well as enabling a personalised learning experience. Teachers are expected to be independent, self-directed professionals (Louws et al. 2017:172). Being self-directed in learning is 'our most basic, natural response to newness, problems, or challenges in our environment' (Guglielmino & Long 2011:2). Self-directed learning can therefore enable teachers to select and use the most appropriate learning styles to present both the study material and assessments for each required context (Thornton 2010:161). It is thus imperative to develop teachers' SDL skills.

## Self-directed learning skills

Ayyildiz and Tarhan (2015:664) identified the following lifelong learning skills needed for SDL. According to Ayyildiz and Tarhan (2015:664), a self-directed learner should be able to ask questions, source information that is relevant, analyse a situation, make considerate decisions, formulate a point of view, determine action to be taken and lastly solve a problem. According to Francom (2010:29), the above-mentioned SDL skills can be fostered through designing training programmes aimed at the development of SDL skills. Francom (2010) asserts that, in order to foster SDL, the following four major guidelines need to be implemented; a self-directed learner should be able to match the level of SDL required in different learning activities; make progress from teacher-directed learning to learner-directed learning; support the combined acquisition of both SDL skills and subject knowledge and learners should practice SDL in the context of learning tasks. These guidelines focus on what facilitators can do to give teachers opportunities to practice SDL skills in their classrooms (Francom 2010:32).

In this paper, a suitable and appropriate intervention, in the form of the PD, was designed to assist teachers in enhancing their SDL. Teachers can be considered self-directed learners when they demonstrate active involvement*, decision-making, implementation of learning paths* in their work, set goals, find relevant information and analyse a situation (Ayyildiz & Tarhan, 2015:665). Opportunities for SDL, in turn, can enhance teachers' professional growth that can also benefit learner's learning in the classroom (Wagner 2011:4).

Knowles (1975:23) however, supports the notion that, learning takes place in association with others and not in isolation. As a result, various teaching–learning strategies such as CL have been associated with the promotion of SDL (Loyens, Magda & Rikers 2008:418). Mentz and Van Zyl (2016:84), believe that CL is an essential aspect in SDL and that working together in small groups can encourage SDL. Cooperative learning as a teaching–learning strategy will be discussed in further detail in the following section.

## Cooperative learning

Cooperative learning provides an environment in which individuals (i.e. teachers) apply their knowledge and skills to support and enrich each other's learning (Johnson & Johnson 2018:61). Through interaction, CL empowers individuals to help one another develop to their fullest potential, in order to achieve a common goal (Felder & Brent 2016:243). Felder and Brent (2016:161) argue that during CL, every individual of a group should have the responsibility to help others to learn, which makes an environment of accomplishment. Johnson and Johnson (2013:107) are of the opinion that this teaching–learning strategy is grounded on the fact that learning is viable when the learners share ideas and work together in a group to complete a given task. Furthermore, this approach encourages appreciation and respect amongst learners (Johnson & Johnson 2009:111). Thus, understanding how to form groups, sustaining individual accountability, ensuring positive interdependence and resolving group conflict are critical aspects of the achievement of a successful CL experience (Millis 2010:4).

After much study in the field of group work and CL, Johnson and Johnson (2013:102) contend that there are five basic elements to be adhered to for successful CL. These are: positive interdependence, individual accountability, promotive face-to-face interaction, appropriate social skills, group processing. These five elements of CL are closely related to the development of SDL (Mentz & Van Zyl 2016:84). According to Johnson and Johnson (2013:102), the five elements of CL need to be present in any cooperative lesson in order for the group activity to qualify as successful CL.

## Cooperative learning strategies

There are a number of CL strategies that have been developed by a number of researchers and each strategy has interesting characteristics for improving learning (Schul, 2011). These strategies include the Jigsaw method, think-pair-share, student team achievement divisions, reading comprehension triads, numbered heads together, round-table and three-step interview.

The teacher PD made use of the Jigsaw CL strategy with the support of different computer application softwares as technological tools to facilitate the content of the session.

Jigsaw is a CL strategy that has been widely executed and studied throughout the years (Doymus, Karacop & Simsek 2010:672). According to Maden (2011:913), there are six different versions of the Jigsaw method:

1. the original Jigsaw
2. Jigsaw II developed by Slavin in 1987
3. Jigsaw III developed by Stahl in 1994
4. Jigsaw IV developed by Holliday in 2000
5. Reverse Jigsaw developed by Hedeen in 2003
6. Subject Jigsaw developed by Doymus in 2007.

The fundamental components of all these versions are all aligned and consist of breaking home group members into small groups, where they become experts on the assigned topic, then regroup back to teach the home group about what they have learnt (Maden 2011:911). When using the Jigsaw strategy, groups are required to split up, gain information and report back to their group (Doymus et al. 2010:671). In this investigation, the Jigsaw strategy could therefore improve teachers learning by ensuring that each teacher was accountable for explaining a section of the material to the group.

## Cooperative learning professional development

Researchers around the world have conducted many studies to prove the positive effect of CL in the field of academia (Callahan 2013:10; Yin 2009:159) and interpersonal relationships (Callahan 2013:11; Mentz, Van der Walt & Goosen 2008:250; Williams 2012:14). The application of the five elements of CL has also proven to be effective for cooperation to work well. Cooperative learning is likely to lead to 'greater interpersonal liking, group cohesion, valuing of heterogeneity, and task-oriented and personal support' (Johnson & Johnson 2008:2). Through CL, individuals help one another to discover knowledge together and benefit from this form of social interaction (Sharan 2014:803). The findings of the study conducted by Johnson and Johnson (2009:111) report that through interaction and building of trust, this allows individuals to communicate without hesitation and thus builds confidence. This investigation used CL as a viable option for teacher PD because CL allows individuals (i.e. teachers) to learn from each other and this gives them an opportunity to maximise their own learning (Johnson & Johnson 2013:449).

The literature on teacher PD shows that this concept has evolved over time. The PD concept is referred to by several different terms, from 'in-service education' to 'staff development', 'PD' and 'current professional learning' (Kriek & Grayson 2009:185). The term 'teacher PD' in the context of teacher education is commonly used to refer to the improvement of teachers' practices (Lampert, 2010:23). Desimone (2009:181) notes that the motivation behind teacher PD is to update, develop and broaden the knowledge, with new skills and professional understanding. Teacher PD is commonly recognised as a significant strategy used to enhance teacher knowledge and skills (Avalos 2011:10). Teacher PD can also be described as any type of continual development of a teacher's professional role (Hirsh 2009:12). For Murtaza (2010:215), teacher PD is one way in which *teachers* can deepen their knowledge while becoming innovative and adventurous in their teaching practices. Deepening teachers' knowledge involves creating and expanding the learning which teachers acquired during their underlying teacher training and, additionally, to provide them with new skills and professional understanding (Avalos 2011:15). It must therefore be recognised that teacher PD is a requirement for all *teachers* to change and update their professional practices in order to overcome the challenges they are faced with in the classroom settings (Verster et al. 2018:2825).

As discussed above, teachers need to be involved in a new strategy of PD, which provides many opportunities for teachers to connect with others, explore topics of interest, regardless of proximity. Technology can therefore be the answer to many teachers' PD, by putting teachers in control of their own learning. The use of technology in a CL environment makes it possible for members to work on the same task simultaneously and actively collaborate in this manner (Assareh & Bidokht 2011:793). Groening (2010:1332) also adds that CL (in a technology-rich environment) allows members to choose the best and easiest method of learning, in the privacy of their own space (and at their own pace). It is clear therefore that TSCL opens new opportunities for better learning and teaching environments by allowing individuals to exchange information, and discuss, encourage and facilitate each other's efforts (Ekizoglu & Ozcinar 2010:795).

In light of the above observations, it is important to make appropriate recommendations with regards to new strategies of teacher PD. In this investigation, the observed TSCL as a PD strategy set out to enhance Mathematics teachers' SDL. Technology-supported cooperative learning professional development will provide teachers with a flexible and convenient way to strengthen and enhance their professional skills through discussing, engaging and interacting with each other. Instead of equipping schools with computers, or sending representatives to be trained and report back, the use of technology in PD creates new possibilities for introducing flexibility for individuals in terms of time, place and pacing of independent study (Assareh & Bidokht 2011:791). The vast amounts of information, communication and cooperation available through technology can therefore provide teachers with the opportunity to become experts in their fields and to meet the demands of the educational challenges for the 21st century (Tondeur et al. 2016:111). As such, it is worth mentioning that the successful PD provides boundless access for teachers to connect with others, explore topics of interests and be a part of opportunities and events across the globe (Tondeur et al. 2016:114).

# Methodology

This section includes a discussion on the research process, research design and methodology that guided this investigation.

## Research paradigm

A research paradigm 'is the perspective held by a community of researchers that is based on a set of shared assumptions, concepts, values and practices' (Johnson & Christensen 2012:31). This investigation was guided by the interpretive research paradigm as its framework because this investigation is based on a view that all individuals have their own unique interpretation of reality and that a single reality does not exist. A qualitative approach is deemed suitable for this investigation as it allows the facilitator to reflect on detailed experiences relating to the design and implementation of the TSCL PD.

## Research methodology: Self-study

Self-study research methodology, as the name indicates, focuses on examining the personal experiences of the researcher in the research study (Hamilton & Pinnegar 2013:75). Samaras (2011:113) proposes specific steps when conducting self-study research. The first of these steps is to create your own questions. Here the researcher proposed questions about his own practice, which they generate from observations of and personal experiences within the TSCL PD. The second step is to work with 'critical friends' (Samaras 2011:75). In this research, the co-authors were engaged as critical friends. The discussions with the co-authors were crucial to the investigation in informing and improving the implementation of the TSCL PD. Although they played a crucial role in the implementation of this research, the main data source reported on in this paper came from the facilitator's (author one) experiences during the implementation of TSCL PD. Step three as suggested by Samaras (2011:15) places greater emphasis on planning new pedagogies for improved learning. The researcher played a very important role with regards to planning engaging activities that enable teachers to acquire new knowledge and skills. The fourth step is to enact, document and assess the research process (Samaras 2011:5). In this step, the researcher has to be open to outside perspectives, questions and potential critiques. The fifth and last step is to create and share what has been learnt throughout the research process (Samaras 2011:252). The findings of this chapter are made public through presentation and publication.

Self-study methodology uses various qualitative methods for collecting data. The use of various methods provides the self-study researcher with an opportunity to obtain different viewpoints on what is being investigated (Hamilton & Pinnegar 2014:156). In this investigation, a reflective journal was used as a data-collection instrument during the observations. The researcher critically observed teachers' learning behaviours, interaction and attitudes, and wrote these observations in his journal. The reflective journal also became useful in collecting some of the descriptive details of the events during facilitation of the TSCL PD.

## The role of the researcher

In this study, the first role of the researcher was to conduct an in-depth literature study in order to examine what the body of scholarship reveals about teachers' needs in terms of TSCL PD and SDL development. This was then followed by a role of acting as an instrument of data collection. The researcher was also responsible for preparing all the necessary documents, scheduling appointments and maintaining trust with all the participants. During the data-collection process, the researcher was non-judgemental and he also avoided giving personal opinions so as not to influence the participants towards a particular opinion.

The researcher also encouraged the discussion by asking open-ended questions and probing for more details with the help of follow-up questions. The researcher's main role was to act as an instrument to give teachers, who participated in this study a voice to share their experiences of the TSCL PD.

## Ethical considerations

This investigation included the first author as participant. Ethical clearance was required for the larger study of which this investigation forms part. Ethical clearance was granted by the NWU Faculty of Education Research Ethics Committee.

## Types of observations

According to Nieuwenhuis (2010:85), there are four different types of observations that are used in a qualitative research. These are, the complete observer, the observer as participant, the participant as observer and the complete participant. This investigation adopted the participant observer approach to data collection. The designer and facilitator of the TSCL PD was the participant and facilitator in this investigation. The facilitator immersed himself in the context of the study, in order to gain a better understanding of teachers' actions and behaviour. He became a participant in the situation being an observer, by intervening with the dynamics of the situation.

Within the qualitative approach, a self-study research methodology was followed. Two additional facilitators were involved in an advisory capacity, which assisted in increasing trustworthiness in the investigation. During the design and implementation of the TSCL PD, the participant reflected in detail on his lived experiences. These experiences were then transcribed and analysed using Saldaña's (2016) guidelines for qualitative data analyses.

## Implementation of technology-supported cooperative learning professional development

The TSCL PD as a PD strategy provides teachers with a flexible and convenient way to strengthen and enhance their professional skills through discussing, engaging and interacting with each other, in a cooperative environment. Technology-supported cooperative learning professional development consists of a small group of teachers, who used technology, supported by CL strategies. The individuals applied their knowledge, supported and enriched each other's learning, as well as directed their own learning. The TSCL PD incorporated multimedia elements such as video streaming, instant messaging, video calling, interactive websites and real-time chat sessions. It can be argued that the TSCL PD offered opportunities that went beyond what could be done in a face-to-face teacher PD. The following section discusses the implementation of the TSCL PD.

### The first session

The first session of the TSCL PD was grounded in the use of GeoGebra, a free interactive Mathematics application which is used in the teaching and learning of Mathematics. Teachers were challenged with different tasks in which GeoGebra was used to investigate straight line functions. The facilitator started the session by explaining to the members that they were going to participate in a Jigsaw activity. The rules included: contributing to the team effort; listening to team mates and helping other team members. The facilitator then divided the teachers into small groups – two groups of three for the 'home group', and three groups of two for the 'expert group' (see Figure 8.1).

The facilitator further assigned different roles to members: the 'leader' (provides direction, instructions and guidance to a

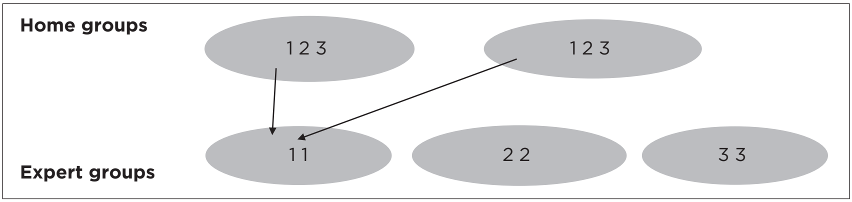


**FIGURE 8.1:** Grouping of teachers.

group), the 'scribe' (records all the answers and ideas that the group generates) and the 'presenter' (presents the group's finished work to the whole class). Each member had a specific role to fulfil; as such every member felt important and needed in order for the group to succeed. The opinion of Johnson and Johnson (2013:102) is that positive interdependence exists once all the learners fulfil their roles.

Expert group 1 had to investigate the role of *m* and *c* in the equation: $\boldsymbol{y = mx + c}$, using sliders. Expert group 2 focused on solving linear equations, using a graphical method. Expert group 3 on the other hand, put greater emphasis on finding the equations of parallel lines, given any point on the line. Members who had the same task (e.g. Expert group 3 – investigating parallel lines) met to form groups of experts, where they were expected to share one computer screen, in order to complete the given task. By allowing members of a group to share limited resources and also to be dependent on one another, positive interdependence was stimulated. The facilitator moved amongst groups to ensure that members helped each other to make associations between concepts, and that they encouraged and facilitated each other's efforts. By members helping each other to connect present and past learning, promotive interaction was also stimulated. Encouraging members to communicate accurately and resolve conflict during the task, ensured that interpersonal and small group-skills were stimulated.

After the expert group meeting, members did not have to move to their home groups, but instead, they would invite their home group members from their respective positions to share their expertise with the group and complete the given task. During this section of work, the group leader would ask critical questions and reflect on the task at all times. The scribe, on the other hand, had to do the task on the computer in preparation for the presentation. The presenter kept record of the time and presented the task to the large group and the facilitator.

After the large group presentation, members were given time to reflect on how well they had accomplished the task and how they could improve as part of group processing. Each member had to reflect on what worked and what did not work during the group activities. Thereafter they had to complete the expert group members' rubric. The expert group members' rubric was designed in order to allow group members to evaluate their commitment to goals, communication with each other and how well they worked together as a team. These actions helped to clarify and improve the effectiveness of the group, thus group processing was stimulated.

## The second session

During the second session, the facilitator again explained to the members that they were going to participate in a Jigsaw activity where they were subdivided into three expert groups. In this session, members worked cooperatively to design a Grade 7 lesson on integers using Google Classroom.

Expert group 1 focused on creating a possible lesson template to use when designing a Grade 7 lesson plan on integers. Expert group 2, on the other hand, focused on collecting more information on mathematical content and interactive websites relating to the Grade 7 lesson on integers. Expert group 3 focused on creating multiple choice quizzes in Google Classroom, on Grade 7 integers.

Expert group members of the same segment (e.g. Expert group 1 – designing a lesson template) joined together and helped each other to begin with the same information and understand the nature of the task; thereafter, they returned to their home groups to complete the task. The facilitator ensured that individual accountability among members was stimulated by providing members with the rubric to use as a guideline at the start of their work. This rubric helped members understand what was expected of them and how their participation would be evaluated. This assisted in avoiding having one person responsible for all the work, and others contributing very little or nothing during the task.

All expert group members used the stream tab of Google Classroom for regular communication with other group members during the task. Mutual respect between group members, conflict resolution, decision-making skills and trust building, contributed to stimulating members' interpersonal and small group-skills. Promotive interaction was stimulated when members helped each other and shared resources during the task. This interaction was facilitated through the use of Google Classroom.

After obtaining information from the expert groups, members had to team up with their home group members, where they worked cooperatively to produce one document authored by the whole group on Grade 7 integers. Here, the group leader had to provide guidance to his or her group, while the scribe on the other hand had to put together all the information required for presentation. The presenter had to present a fully designed Grade 7 lesson on integers to the whole group.

After task completion within the home groups, members were given time to share with each other regarding what actions did not work or were not acceptable and complete the expert group members' rubric. Feedback from the group members gave an indication about which aspects were difficult and therefore needed extra attention. When members looked back on how they worked together, as well as reflecting on their process and discussing what worked and what did not work, group processing was stimulated.

## The third session

The facilitator assigned members into different roles of a leader, a scribe and a presenter. The group leader studied and read the material to the rest of the group. After everyone was familiar with the material, members were divided into three expert groups where they had to prepare a Grade 6 test on measurement, using real-time collaboration with Google Docs. Members of each expert group were given a task, which had to be completed in limited time, in order to encourage members to rely on each other, as well as to stimulate positive interdependence and individual accountability. During these tasks, members had to work with each other in order to reach a mutual goal. The facilitator moved from group to group, observing the process and implementing appropriate intervention. The visibility of the facilitator also promoted individual accountability.

Promotive interaction was stimulated when expert group members exchanged information, discussed, encouraged and facilitated each other's efforts. This was established when expert group members invited other members to access the document through Google Docs. Other group members were able to read an edited version of the document. In addition, group members were able to open up the Google Docs messenger feature and chat with each other. Group members could write in the document, about the changes they want to make simultaneously and synchronously. This allowed members to engage in democratic decision-making, accepting and supporting each other, as well as allowing effective communication, thus stimulating interpersonal and small group-skills.

After task completion within the expert group, members returned back to their home group using their codes, where they compiled a final version of a test for presentation. During this section of work, the group leader would ask critical questions and reflect on the task at all times. The scribe on the other hand would do the task on the computer as a preparation for the presentation. The presenter would present the prepared Grade 6 test on measurement to the whole group.

After the large group presentation, members shared their experience, discussed how the problem could be solved differently and also completed the group members' rubric. When members looked back on how they worked together, as well as reflecting on their process and discussing what worked and what did not work, group processing was stimulated.

# Findings

In order to answer the research question 'How does a facilitator experience the implementation of technology-supported cooperative learning professional development?' the facilitator reflected on the following aspects relating to the TSCL PD: teachers as self-directed learners; CL observed; the use of technology in PD and general observations.

## Teachers as self-directed learners

Self-directed learning demands teachers to change their roles and take on new responsibilities of being active learners who are able to adapt and learn in a fast-changing environment. This theory enables teachers to choose and use the most suitable learning styles. The learning process of choosing appropriate learning styles gives teachers the opportunity to explore ideas, set goals, plan and evaluate their learning. This self-directedness is an important characteristic of PD.

During the TSCL PD, the facilitator assisted in promoting the teacher's SDL through giving support and guidance. Merriam and Brockett (2007:107) recommend that facilitators should give less support so that learners (i.e. teachers in this case) can have greater control over their own learning. The facilitator paid much attention when teachers approached him and he formulated his responses such that they guided teachers, leading them in directing their own learning process. Additionally, in the beginning of every session, the facilitator explained the importance of CL to the teachers and also made teachers aware of how resolving group conflict and explaining content and solutions to each other, improves their own understanding. According to Knowles (1975:23), self-directed learners should be given opportunities to teach others, so that they can reinforce their own knowledge and understanding.

The facilitator noticed evidence of SDL skills during the facilitation of TSCL PD. According to Francom (2010:32), SDL skills can be fostered by putting into practice effective teaching and learning strategies. The foremost common SDL skills as is evident from the TSCL PD sessions are: decision-making, finding relevant information and taking responsibility for own learning. For instance, during group activities, teachers would listen and build on the ideas of others or negotiate their ideas with others, which is a sign of making decisions on what is best for the benefit of the individual member and for the group. Teachers would also work independently on their computes to find relevant information, in order to complete the assigned task. The facilitator allowed teachers to take risks and make mistakes during their use of technology, then gave them time to discuss on how they can fix the mistake, and this helped teachers to be accountable for their own learning.

Dynan, Cate and Rhee (2008:100) assert that the development of the above-mentioned skills will equip teachers with opportunities of becoming lifelong learners and this leads to a better understanding of one's own strengths and weaknesses. The realisation of the above-mentioned skills, as well as the ability to use a different methods to achieve learning goals, is a strong indication of self-directedness (Guglielmino 2013:11–12). It is through such endeavours that teachers have the potential to reach a more comprehensive understanding of these environments and in so doing are then able to meet the demands of educational challenges for the 21st century.

The facilitator also experienced a great deal of confidence among the teachers and a strong desire to learn with each other during the sessions. For instance, teachers were responsive to their group members' questions and they also showed empathy for other colleagues. In addition, teachers were open to new ideas and diverse viewpoints in their respective groups. According to Guglielmino (2013:3), developing a set of the above-mentioned characteristics enables teachers to become self-directed in their learning. As mentioned above, there are numerous measurable characteristics of a self-directed learner. Some of these characteristics are, for instance; being motivated to learn how to use different computer software, linking learning content to real-life context and sharing personal experience. These were evident in the TSCL PD sessions.

Self-reflection as a sign of readiness for SDL, was also noticed during the TSCL PD sessions. At the end of every session, teachers were encouraged to reflect on their work processes, how well they have accomplished the task, how they could improve on their role in the group and on how effectively the group members worked together. From these reflection sessions, the facilitator noticed that teachers were free to express their own opinions, they were honest to themselves and they showed a deeper level of thinking. Being able to engage in self-evaluation and self-reflection allows teachers an opportunity to think deeply about their learning process and this, according to Thornton (2010:161–164), is a key aspect of lifelong learning.

## Cooperative learning observed

Johnson and Johnson (2013:121) also make it clear that the most important aspect of group effectiveness is 'sharing' because it builds trust within a group. The use of technological tools and applications like Google Docs and Google Classroom (for cooperative writing and reflections through chatting), as well as Google Hangout (for videoconferencing and sharing computer screens) provided teachers with an opportunity to share their ideas and accomplish the given tasks, even when they are apart. By sharing resources, facilities and ideas, teachers ensured that positive interdependence existed within their groups. Additionally, the sharing of ideas with colleagues, as well as respecting each other during group work, allows positive interpersonal relationships to be developed.

It was noticeable that there was an atmosphere of trust during the TSCL PD sessions. Throughout the sessions, it was clear that teachers felt comfortable to approach each other, as well as the facilitator when they needed assistance. Even though teachers were not sitting next to each other, they all had a sense of trust and knew that when help was needed, it would be provided. The facilitator accepts that this kind of sharing was encouraged based on trust among the group members and the support that they gave each other for their groups to succeed.

The facilitator paid close attention to the roles that were assigned to each individual group member and how these roles were fulfilled. It was noticed that assigning roles to individuals helps with providing a clear avenue for participation. Each participant had a specific role to fulfil in order to succeed; therefore, every participant felt important and needed in the group. According to Johnson and Johnson (2013:102), assigning specific roles to teachers is vital to high-quality learning as it stimulates both individual accountability and positive interdependence. During the TSCL PD sessions, it was observed that teachers learnt to accept each other as individuals; also they worked well together compared to one person working alone.

The facilitator observed that the teachers were open in expressing their opinions during the group discussions and the reflection sessions. The ability to reflect on what, why and how things were done and to adapt and refine practice is essential for professional growth of teachers (Felder & Brent 2016:246). Teachers reflecting on CL experiences and the success of the group, points to the ability of taking responsibility and managing their own learning. Being able to reflect and evaluate one's own learning process is a necessary characteristic of a self-directed learner.

## The use of technology in professional development

The common requirement amongst many studies is that, technology should form part of teachers' PD (Johnson & Johnson 2014). The use of technology in PD can offer more opportunities than what the traditional PD strategies offered. It has also been observed that the use of technology in TSCL PD provided flexibility in a way that makes it possible for teachers to split the work equally, while working on the same task (Assareh & Bidokht 2011:793). Technology forms an important component that can inspire teachers, assisting them with the challenges of the teaching profession and promote their lifelong PD (Kriek & Grayson 2009:186). Such a PD strategy can create an opportunity for teachers to share ideas and material regardless of geographic proximity (Assareh & Bidokht 2011:791).

The facilitator observed that the use of technology in PD and the Internet not only enhanced the teachers' knowledge and skills in terms of their teaching and learning, but also improved their interest, understanding and concentration. This point is also supported by the work of Veletsianos (2010). Veletsianos (2010:74) states that, the Internet encourages teachers to conduct independent research and this, according to Thornton (2010:161), is another aspect conducive to SDL development. Having access to worldwide databases enhanced teachers' access to information by making searching convenient, easy and quick. It is the view of Johnson and Johnson (2014) that, by having access to thousands of books, games, websites, etc., teachers realised that their interactive teaching methods, supported by the Internet, can be enhanced, such that they can give more attention to individual students' needs and support.

The facilitator also noticed that sharing of information was highlighted as a source for better insight within the groups. Through different technological applications, the teachers managed to share resources, screens and ideas and these helped them to develop in terms of their confidence as well as building good working relationships. With the support of technology in PD, the nature of communication has changed along with its increase in information and proximity. This allows for access to even deeper layers of connection with others, making it easier to work with colleagues, even if they are in remote areas, as if they are right next to you.

## General observations

In all the TSCL PD sessions, the facilitator observed that teachers demonstrated enthusiasm in the deliberations of the PD session. It was also necessary for the facilitator to observe how the group leaders were able to keep the groups interested and involved in tasks. The facilitator was also determined to discover if the teachers were able to use the supplementary material, use practical examples and sharing personal experiences to illustrate their points. By observing teachers' behaviour, listening, as well as interacting with them, afforded the facilitator an opportunity to obtain rich data.

Based on my experience as a developer and an implementer of the TSCL PD, I have experienced that the teachers seemed to be interested in the TSCL PD and found it to be an effective platform to voice their challenges. The teachers seemed to enjoy being actively involved in the learning activities. In addition, teachers liked to be engaged in the process of PD activities that were hands-on and content specific, which allowed them to improve their teaching practices, so that they could meet the demands of classroom practices. This was in line with the literature where various facilitators advocate for teacher development models that are practical and happen in multiple cycles in order to develop in-depth knowledge, skills and practices of the teachers (Opfer & Pedder 2011:376; Smith & Gillespie 2007:233; Steyn 2008:23).

The facilitator observed the body language of the teacher and noted the enthusiasm and the pleasure that the participant experienced as a result of using technology-supported by CL strategies in the PD session. It was interesting to observe that many of the teachers had a stronger feeling of ownership and this allowed them to use different methods to achieve their learning goals. The facilitator's observation confirms that teachers were dedicated in terms of how they used technology during the sessions and this does indeed fulfil teachers' aspirations, enabling them to make decisions about what, how and when to take part in learning. Given this evidence, it can be seen that the teachers found great value in attending these sessions.

## Discussion and recommendations

Technology-supported cooperative learning professional development incorporated five basic elements needed for implementing CL to enhance SDL. The basic elements were observed as follows during the TSCL PD sessions: *positive interdependence* (teachers realised they needed each other), *promotive interaction* (teachers encouraged and supported each other) *individual accountability* (each group member was accountable for completing a given task), *interpersonal and social skills* (teachers listened and communicated well with each other) and *group processing* (teachers reflected on their process and discussed what worked and what did not work during the TSCL PD).

At the end of each session, all teachers recognised the value of the TSCL PD as an approach to acquiring the necessary competencies to work effectively. The impact of acquiring and exchanging information using technology, active participation and working in small structured group were cited as reasons why the teachers perceive themselves as self-directed learners during every reflection session. A point worth mentioning is that during the implementation of TSCL PD, the facilitator noticed that all teachers seemed to experience a higher level of ownership towards their learning. It further appeared that teachers relied, shared, respected and trusted each other throughout the TSCL PD sessions.

In light of the above-mentioned findings, the facilitator recommends that teachers should be exposed to PD that accommodates the following key processes: using technology for the exchange of information, ideas and research; allowing for cooperation amongst teachers and allowing time for reflection and flexible learning. As lifelong learners, teachers should have an opportunity to participate in PD conducted at a time and place that would suit them. The facilitator recommends teacher PD that focuses on 21st-century skills. A new set of skills is required from teachers in order to teach learners of the 21st century successfully.

## Conclusion

This chapter has reported on the facilitator's experiences on implementing the TSCL PD. Participants enjoyed being involved in the process of PD activities which were hands-on, content specific and allowed for improving their teaching practices. The facilitator experienced that technology helped teachers to become more independent in their learning and more interconnected with other teachers. This investigation offers new evidence, as well, the fact that the use of TSCL strategies, influences the PD of teachers, which results in a more personalised learning experience that could also benefit teachers' professional growth as observed by the facilitator.

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Chapter 9

# Using cooperative learning as scaffold to develop Grade 10 Life Sciences learners' self-directed learning skills within their zone of proximal development

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# Abstract

This chapter reports on the findings of a mixed-methods study, within a pragmatic paradigm. The focus of this study was to investigate the use of CL as scaffold to develop Grade 10 Life Sciences learners' SDL skills within their zone of proximal development (ZPD). The adapted Self-Directed Learning Instrument (SDLI) of Cheng et al. (2010) was used to gather the quantitative data before and after the implementation of the CL intervention. In this regard, the SPSS, version 23, was used to perform a factor analysis and to determine the effect sizes. The learner and teacher interviews and the teachers' journals, as the qualitative data sources, were transcribed and analysed according to Saldaña's (2009) method of coding. The results of the quantitative part of the study indicated no practically significant differences with regard to the participating learners' self-directedness (or the development of their SDL skills). The findings based on the interview data obtained from the learners, however indicated that CL did develop the learners' SDL skills contributing to their self-directedness in learning. The ZPD was used as a theoretical lens to explain the findings.


**Keywords:** Self-directed learning; Cooperative learning; Zone of proximal development; Life Sciences; Self-monitoring.

# Introduction

The current vice-chancellor of the University of Johannesburg, Tshilidzi Marwala, argues that the fourth industrial revolution (4IR) is here, and it is here to stay (Chauke 2018). According to Marwala, the 4IR 'marks the advent of the digital era' and is 'about cyber-physical systemisation, artificial cognition (intelligence) and robotisation' (Chauke 2018). In another publication, Marwala further argues that, although some jobs will become redundant, artificial intelligence (AI) will never replace all jobs. According to him, jobs with a 'human touch' are going to survive the 4IR, and therefore, the need exists for the current professional class to re-skill themselves to more human-centred characteristics rather than task-based characteristics (Xing & Marwala 2017:10). Marwala also mentions that the following skills are required by citizens to be employable during the digital revolution age: 'cognitive abilities, systems skills, complex problem-solving skills, content skills, process skills, social skills, resource management skills, technical skills and physical skills' (Chauke 2018). In an article posted by the Skillsportal (2019), the author of the article added the following skills required by employees to be successful in the 4IR: critical thinking, creativity, taking responsibility and ownership of own learning, people management, coordinating with others, emotional intelligence, judgement and decision-making, service orientation, negotiation and cognitive flexibility. The South African school curriculum also requires from teachers to develop problem-solving, critical and creative thinking within learners, and creating opportunities during which learners can learn how to work effectively as individuals and with others in a team (South Africa 2011). The 4IR plays off in a context of a constant increase of the amount of information available (Brock & Buckley 2013:272). More information has been produced in the past 30 years than over the previous 5000 years (Jungwirth 2002:89). These statistics are an indication of an 'information explosion' that could lead to numerous implications for citizens, such as how to deal with all the available and continuous changing information in order to operate optimally in the work place. Quigley and Herro (2019:ix) argue that in a complex world, success is determined not by 'what' we know but what you 'can do' with what you know. While Marwala argues that the existing workforce needs re-skilling (Chauke 2018), we argue that these higher-order cognitive skills as mentioned above should also be fostered amongst school learners to enable them to operate functionally in this 4IR era and to equip them for future studies and employment.

## ■ Problem statement

In the previous paragraph, the authors of this chapter argue that higher-order cognitive skills should be fostered amongst school learners. This implies that schoolteachers should possess the necessary pedagogical content knowledge to create teaching–learning opportunities where these particular skills, referred to as SDL skills, can be developed. In this chapter, we argue that these SDL skills can be fostered within learners if teachers use various learner-centred teaching–learning methods to enhance the learners' self-directedness in learning.

However, the reality in many South African classrooms is that teachers use predominantly teacher-centred teaching–learning strategies, mainly because they do not possess the necessary competencies to use learner-centred approaches to teaching–learning practices as well. During teacher-centred lessons, learners are usually passive recipients of knowledge and their self-directedness is not developed, while a learner-centred approach to learning creates ample opportunities for learners to enhance their self-directedness (Petersen & Mentz 2016:55). For this to happen, the focus must move from teacher-centred to learner-centred approaches. It is the teacher's responsibility to create teaching–learning opportunities for the learners to acquire knowledge and develop skills that can promote their self-directedness for them to become lifelong learners. The teacher needs to provide learners with options regarding the learning process and ways to select information to ensure the successful execution of the learning goals. Keeping in mind that teachers need to provide for every learner's diverse learning needs, research shows that teachers' teaching strategies are generally outdated and lacking the ability to use learner-centred teaching–learning methods (Francom 2011:6).

In order to contribute to the improvement of Life Sciences teachers' implementation of learner-centred teaching–learning approaches, this study exposed participating teachers to CL and ways in which it can be used effectively during their teaching in order to develop their learners' self-directedness in learning. Even though CL has been well documented, a limitation exists regarding the training of Life Sciences teachers in introducing CL as a teaching–learning strategy in the classroom and the effect it may have on the learners' self-directness in learning. The participating Life Sciences teachers were trained to use CL as a scaffold to teach the Life Sciences subject content knowledge with the aim to foster their learners' SDL skills. The research question that this study addressed was therefore: Which influence did the implementation of CL as scaffold have on the Grade 10 Life Sciences learners' SDL skills within their ZPD?

## Theoretical and conceptual frameworks

The theoretical and conceptual frameworks are discussed below.

### Theoretical framework: Vygotsky's zone of proximal development

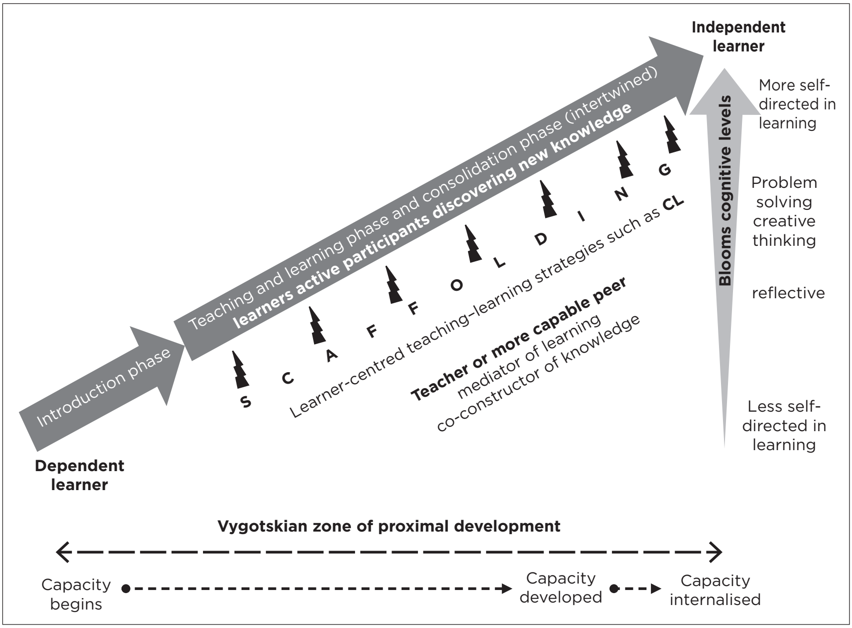
According to Powell and Kalina (2009:241), constructivism can be regarded as the 'best method for teaching and learning'. Tobin (1990) argues that constructivism implies that teachers should create opportunities for learners to experience what they are about to learn in a direct way and time to reflect on what they have learnt in order to make sense of the newly learnt content. Teachers can successfully implement a constructivist approach if they are aware of the learners' prior knowledge at a given learning point.

Vygotsky can be regarded as the father of social constructivism because he strongly believed that social interactions form an integral part of learning (Powell & Kalina 2009). Vygotsky made considerable contributions to the field of cognitive development with various learning concepts, the most famous being the ZPD. The ZPD, as conceptualised by Vygotsky (1978), was used in the current study as an analytical lens to study the findings reported in this chapter. The ZPD demands that there must always be a person present in a group who knows more or understands better (a teacher of more knowledgeable peer), enabling educational scaffolds to be used to promote independent learning.

Vygotsky also realised that individual capacities can be better developed in a socially supported environment. Vygotsky (1978) defines ZPD development as follows:

> [*T*]he distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with a more capable peer. (p. 86)

With proficient assistance provided by an adult (teacher) or more capable peer (group mate), Vygotsky believes that a learner can achieve the task successfully (McLeod 2018:1). McLeod (2018:2) describes the activities provided by the teacher or more capable peer to offer assistance as 'scaffolding'. In this regard, Wood, Bruner and Ross (1976:90) define scaffolding as a process 'that enables a child or novice to solve a task or achieve a goal that would be beyond his unassisted efforts'. According to Nasir et al. (2014), scaffolding can be regarded as the guidance provided that would enable learners to master a difficult task, beyond their current set of knowledge and skills, easier. Learners then internalise the assistance received from others, and it becomes part of their own range of skills to direct future problem-solving (Darling-Hammond et al. 2019). In this study, CL as teaching–learning strategy was introduced as scaffold to the participating Life Sciences teachers in order for them to implement CL in their classrooms. According to Darling-Hammond et al. (2019), the right kind of support, during well-designed teaching–learning experiences within the ZPD, will help nudge the learner to a new level of understanding. The authors of this chapter are of the opinion that CL could provide suitable scaffolding in such well-designed teaching–learning experiences. Figure 9.1 presents a summary of how scaffolding can be used in the ZPD in order to develop learners' higher-order thinking skills as well as how their self-directedness in their learning can be influenced. The ZPD can be linked to the promotion of SDL through the teacher creating learning opportunities where problems can be solved independently, and effective learning can take place.




*Source*: Petersen (2018).

**FIGURE 9.1:** Scaffolding in the zone of proximal development.

## Conceptual framework

In the paragraphs that follow, SDL, Life Sciences teaching and CL will be elaborated on as the conceptual framework of this chapter.

### Self-directed learning

According to Hiemstra (1994:2), the concept of SDL is centuries old, and it was used by renowned philosophers such as Plato, Aristotele and Descartes. De Beer and Mentz (2016) argue that the holders of IK were and still are self-directed learners, and their self-directedness can be traced back to their day-to-day needs to survive in authentic contexts.

Self-directed learning is a well-established concept amongst educational experts and is a learner-centred approach (Van Deur & Murray-Harvey 2005:1). Knowles (1975) defines SDL as:

> [*A*] process in which individuals take the initiative, with or without the help of others, to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes. (p. 18)

Self-directed learning, according to Guglielmino (2013), can be described as the process of planning, evaluating and implementing personal learning needs, which is a crucial skill required by independent thinkers. Long (2005:1) claims that self-directedness in learning is a cognitive attribute that could be enhanced by certain activities. Self-directed learning focuses on the learners' ability to self-assess their learning needs and to make use of additional activities (research, inquiries and curiosity), if necessary, to gather more information (Van Deur & Murray-Harvey 2005:2).

The progress of self-directedness in learning can be placed on a continuum with the aim to have learners moving from a lower level of self-directedness to a higher level of self-directedness (Guglielmino 2013:2). The assumption can therefore be made that a learner possessing more SDL skills will have a higher level of self-directedness and vice versa. According to Candy (1991:321), self-directedness in learning cannot be regarded as a defining characteristic, because it can be different in different aspects of a person. For example, a learner's level of self-directedness in learning can be developed in one subject (for example, Life Sciences) through the implementation of certain teaching–learning strategies, such as CL and other active teaching–learning methods, but not developed in another subject because teaching–learning strategies applied in that subject do not promote the development of SDL skills.

Teaching–learning strategies that researchers found to contribute to the development of SDL skills are amongst others, PBL (Ali & El Sebai 2010), CL (Felder & Brent 2007) and metacognition (Robertson 2011). During PBL, learners solve ill-structured and authentic problems. While solving the problem, they work collaboratively to discuss and plan approaches to tackle their gaps in knowledge while reflecting on their progress. Problem-based learning could contribute to develop SDL skills as learners play an active role in planning, monitoring and evaluating their learning process (metacognitive abilities), while solving the problem. In the process, their metacognitive skills are also developed. If accompanied by teaching strategies, such as CL, this could possibly fill the current generation's learning needs by independent studies, continuous discoveries and lifelong learning. The aim of the current study was to investigate whether the implementation of CL, when used as scaffold, can develop Grade 10 Life Sciences learners' SDL skills within their ZPDs. Life Sciences content was used in a CL environment to scaffold the development of the participating learners' SDL skills.

## Life Sciences teaching

Life Sciences is a sub-discipline of Natural Sciences and is fundamentally an investigative subject discipline (SA 2011). The Life Sciences school curriculum is loaded with content to be mastered, and it is envisioned that learners' (higher) cognitive, psychomotor and affective skills will be developed in the process. In order to develop these skills within learners, they should be exposed to the holistic nature of what Natural Sciences encompass. According to Abd-El-Khalick, Bell and Lederman (1998), the nature of science (NOS) can be described in terms of its tenets, namely:

> [*S*]cientific knowledge is tentative (subject to change); empirically based (based on and/or derived from observations of the natural world); subjective (theory-laden); partly the product of human inference, imagination, and creativity (involves the invention of explanation); and socially and culturally embedded. (p. 418)

Understanding the NOS appears to be an important factor influencing the learning processes of science, and many students and teachers of all ages continue to hold poor and naïve views of NOS (Dogan & Abd-El-Khalick 2008). According to Van

Aswegen et al. (1993), the NOS can also be described in terms of its substantive and syntactic components, and both these components should be included during teacher education. According to Schwab (1964, cited in Anderson & Clark 2012:316), the substantive component refers to the understanding of the subject knowledge (the 'what' aspect), while the syntactic component refers to the understanding of the way in which the subject knowledge is acquired (the 'how' component) from a particular subject area. In this chapter, the authors describe how CL can be used as a scaffold (suitable teaching–learning strategy = syntactical structure) to teach the Life Sciences content in order to develop their SDL skills within their ZPD. With such an intervention, the authors hope that the learners might have a better understanding of the NOS as well.

## Cooperative learning

Because of the misconceptions about CL and group work, it is important to distinguish between the two concepts. According to Johnson and Johnson (1999), group work consists of a task being divided into segments and each learner in the group completing only one part and putting everything together. Various definitions of CL exist in literature. Zook (2018:1) defines CL as 'the process of breaking a classroom of students into small groups so they can discover a new concept together and help each other learn'. Adams and Powell (1994:2) define CL as a small cooperative group activity within a space of intellectual exchange to develop critical thoughts and problem-solving skills. This study leant heavily on the definition of CL coined by Johnson and Johnson (1994) who see CL as a learner-centred activity requiring active participation of all members in the group trying to achieve a common goal. Johnson and Johnson (1994) further suggest that the groups should be as small as possible, preferably between two and four members, depending on the cooperative teaching–learning method that will be used to achieve the lesson outcomes (common goal of the group). For effective CL to take place, the following five elements need to be present in teaching–learning activities (Johnson & Johnson 1999:2):

### □ *Positive interdependence*

Responsibility is shared within the group, and the need for the group to pursue a common goal is emphasised. The interdependence and cooperation amongst group members will determine whether the learning outcome will be achieved. Johnson and Johnson (1994:2) refer to it as the 'sink-or-swim-together' principle. Teachers can use the following practical tips to ensure the presence of positive interdependence (iStudy 2014):

- only supply the group with one pen, paper, book or resource
- only one paper or task should be handed in
- a task must be subdivided into smaller tasks that cannot be completed without the help of every member in the group
- offer positive reinforcement (rewards) if all members of the group complete the task successfully.

If structured correctly, each member in the group is actively involved in the formulation of the group goals and the identification of resources (Johnson & Johnson 2013), and we can therefore argue that positive interdependence can contribute to the development of SDL skills.

### □ *Face-to-face interaction*

During interaction, the learners communicate with one another to encourage and facilitate the understanding of new content. Verbal and non-verbal interaction contributes to the conceptualisation of information. Teachers can use the following practical tips to ensure the presence of face-to-face interaction (iStudy 2014):

- learners need to explain verbally how a problem can be solved
- one member at a time may discuss a concept (possible solution) with the others

- each member is granted the opportunity to teach the other members about a topic, creating a space for interaction through questions
- learners help each other to connect past and present experiences to assist them with learning.

### ☐ *Individual accountability*

Each group member is accountable for the execution of duties as assigned to them to achieve the common goal. The aim is for group members to work together but also to learn individually during the process. Teachers can use the following practical tips to ensure individual accountability (iStudy 2014):

- each group member is responsible to complete his or her section of the task first, before it is discussed and combined to complete the task
- the teacher chooses a group member at random to ask about the content of their completed task. This ensures that all members have to understand all the content to be mastered
- each member is responsible to complete a copy of the task and the teacher may choose any member's task to assess
- each member of the group receives a chance to rehearse the information out aloud for the group, while the teacher observes.

According to Johnson and Johnson (2013), both promotive face-to-face interaction and individual accountability can contribute towards the enablement of students to be in a position to identify their own learning needs and choose appropriate learning strategies while executing the common goal. These are typical characteristics of a self-directed learner.

### ☐ *Interpersonal and small group skills*

Various social skills are needed to function effectively in a group, namely reliability, leadership, decision-making, communication and conflict management. These skills can be developed through guidance. Teachers could use the following practical tips to ensure the development of interpersonal and small group skills (iStudy 2014):

- group members will need to be rigid about their time management
- group sessions will require the members to listen to each other and to give each other the opportunity to voice their opinions and ideas
- members will need to use encouraging language to prevent miscommunications that could lead to conflict
- conflict does not need to be avoided but should be managed in a mature and respectful manner.

### ☐ *Group processing*

Group members need to use self-reflection and group reflection to evaluate to which degree the common goal was achieved and how future activities could be managed more effectively. Teachers could use the following practical tips to ensure successful group processing (iStudy 2014):

- each learner in the group should be given an opportunity to discuss his or her own strengths and growth areas and also those of the other group members. In this way, growth areas are identified from which each member can learn
- discuss as a group which practices, strategies and approaches have been successful and which can be used again.

Group processing creates the space for the development of certain SDL skills, namely self-reflection and evaluation of the learning outcomes (Johnson & Johnson 2013).

The implementation of these five elements during CL provides the opportunity for individuals to construct knowledge within a social environment with the aim to develop SDL skills. Various teaching–learning methods can be used to implement CL in the classroom. To name just a few: Jigsaw method, De Bono’s thinking hats, GIG (Group, Individual, Group), note-taking pairs, cooperative graffiti, think-pair-share and the TASC (Thinking Actively in a Social Context) wheel (Wallace et al. 2004). In the intervention during the current study, participating teachers presented different CL lessons, which were designed in such a way that all these elements were present during the teaching–learning experiences.

# Methodology

In the paragraphs that follow, the methodology underpinning the study reported in this chapter will be discussed.

## Research method

A mixed-methods research design within a pragmatic paradigm was used to find answers to the research question. Focusing on the research question, appropriate research methods were selected and implemented (Venkatesh, Brown & Bala 2013:37). Quantitative data were gathered through the adapted Cheng et al.'s (2010) SDLI in a pre-test and post-test experiment with both experimental and control groups to determine the participating learners' self-reported SDL skills before and after implementation of CL as a scaffolding teaching–learning approach. During the intervention, the participating teachers in the experimental group designed and presented lessons using the Jigsaw method, De Bono's thinking hats and the TASC wheel as examples of CL methods, incorporating the five basic elements of CL (Johnson & Johnson 1994) to ensure effective CL. Based on a basic qualitative research approach (Merriam 2009), qualitative data were gathered through structured interviews with both learners and teachers, and through teachers' reflective journals, to determine the influence of using CL as scaffold on the development of learners' SDL skills within their ZPD.

## Sample

To ensure that the research was meaningful in teaching practice, purposive sampling was used. Invitations to participate in the research were sent to all teachers who taught Grade 10 Life

Sciences at the time and their learners in the Kenneth Kaunda District in North-West. Purposeful sampling was used because only Grade 10 Life Sciences teachers were invited to participate. Eight of these teachers in the vicinity of Potchefstroom were conveniently chosen to participate. With the consent of their school principals, four of the eight teachers voluntarily agreed to participate as the experimental group along with their learners, while the other four teachers and their learners formed the control group. The four schools that participated as experimental group comprised 59 Grade 10 Life Sciences learners who completed both the pre- and post-tests, while the control group comprised 65 such learners. Learners who did not complete either the pre- or post-test were omitted in the data analyses. The sample comprised different genders and race groups, but all learners had full command of the languages of teaching and learning at the respective schools, which were English and Afrikaans.

## Intervention

After completion of the pre-test, the participating teachers in the experimental group attended an interactive workshop to ensure that they were equipped to implement the intervention meaningfully. The workshop aimed to provide the teachers with essential knowledge about SDL and to develop their skills in implementing CL methods in the Life Sciences classroom. The incorporation of the five basic elements necessary for the effective application of CL in the Life Sciences classroom were emphasised continuously. The three suggested CL methods (Jigsaw method, De Bono's thinking hats and the TASC wheel) were then explained and discussed in detail, with application in complete lesson plans with content relevant to the Grade 10 Life Sciences curriculum. Attendance of the workshop was meant to enable the teachers to implement these three CL methods effectively and apply them in the classroom. During the implementation phase of the intervention, the teachers implemented their newly acquired knowledge and skills about

CL in their classrooms and were expected to have presented at least 15 CL lessons before the post-test took place. The teachers kept a reflection journal on their experiences during the intervention.

## Data collection and instrumentation

For the pre- and post-tests of the qualitative data collection, an adapted version of Cheng et al.'s (2010) SDLI was used to determine the participating learners' self-reported SDL skills before and after implementation of CL as a scaffolding teaching–learning approach. The SDLI consists of 20 questions, which are categorised into four broad areas (domains) of SDL:

- learning motivation (inner drive to learn and taking responsibility for own learning)
- planning and implementing (ability to set learning goals independently and to select and use appropriate learning strategies and resources)
- self-monitoring (ability to evaluate own learning and to progress)
- interpersonal communication (ability to interact with others to promote own learning) (Cheng et al. 2010).

All items on the questionnaire are positively stated items, and responses were rated on a five-point Likert-type scale, where 1 represented 'never' and 5 represented 'always'. The minimum score for the questionnaire is 20 and the maximum score is 100. The reliability of the SDLI as a whole, as well as the four domains, had originally been confirmed by acceptable Cronbach's alpha coefficient values (Cheng et al. 2010). In the current research, the reliability of the questionnaire for the specific population was confirmed by an acceptable Cronbach's alpha coefficient value of 0.76. The quantitative data were analysed using SPSS (version 23), an electronic statistical programme used for processing and interpretation of numerical data (Garth 2008). A factor analysis of the questionnaire and both dependent and independent *t*-tests was done, and effect sizes were determined.

After completion of the post-test, structured interviews were held with 17 learners. An open invitation to participate in the interviews was given to all Life Sciences learners of the teachers in the experimental group. The 17 learners, a combination of learners from all four schools in the experimental group, volunteered to participate in the interviews. The four teachers from the experimental groups' schools were also invited to participate in structured interviews after the observation of their classes, and they were expected to keep a reflection journal daily during the intervention period. The learner and teacher interviews, as well as the reflective journals of the teachers, were transcribed and analysed according to Saldaña's method of coding, namely coding, categorising and theme identification (Saldaña 2009). ATLAS.ti™ served as a tool to identify the relevant segments from the text. The conceptual and theoretical frameworks used in this chapter guided the identification of categories and themes. Transcripts were checked for correctness, and codes, categories and themes were cross-checked by other experts in the field of study to ensure reliability of the process.

## Ethical considerations

The research complied with all requirements of ethical research. Permission was obtained from the relevant research ethics committee, education authorities and school principals. Informed consent was obtained from the participating teachers, as well as from the learners' parents. Informed assent was obtained by the learners. Participating learners were informed that they had the right not to complete the questionnaires or to participate in the individual interviews. The teachers had the right to withdraw from the research at any time without any adverse effects. The intervention was part of the teachers' normal plan to cover the curriculum. The learners were therefore obliged to attend all classes and were subject to the intervention. Those learners who agreed to participate in the interviews also had the right to withdraw at any time without any adverse effects. The participating schools, teachers and learners were assured that all data would be treated confidentially.

# Results and discussion

The SPSS (23rd version) was used to analyse Cheng et al.'s (2010) SDLI. An investigative factor analysis and effect size calculation were done. The factor analysis (Table 9.1) yielded seven factors, four of which were extracted as they represented the vast majority of the total variance. These four factors were aligned with the themes that emerged from the interviews. The four factors are as follows: The learners can take responsibility for their own learning; The learners can identify their own learning strategies and challenges; Learners can self-monitor their own learning; and Learners acknowledge the value of learning with others in the group.

**Table 9.1:** An investigative factor analysis

| | Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| **Variance** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| V9 | 0.82 | - | - | - | - | - | - |
| V1 | 0.42 | - | - | - | - | - | - |
| V7 | 0.35 | - | - | - | - | - | - |
| V2 | 0.32 | - | - | - | - | - | - |
| V5 | - | 0.63 | - | - | - | - | - |
| V10 | - | −0.42 | - | - | - | - | - |
| V6 | - | 0.40 | - | - | - | - | - |
| V4 | - | 0.36 | - | - | - | - | - |
| V16 | - | - | -0.90 | - | - | - | - |
| V19 | - | - | - | - | - | - | - |
| V14 | - | - | - | 0.90 | - | - | - |
| V20 | - | - | - | - | 0.67 | - | - |
| V12 | - | - | - | - | - | -0.60 | - |
| V15 | - | - | -0.42 | - | - | -0.54 | - |
| V11 | - | - | - | - | - | -0.44 | - |
| V18 | - | - | - | - | - | - | 0.61 |
| V13 | - | - | - | - | - | -0.35 | 0.38 |
| V17 | - | - | - | 0.33 | - | - | 0.33 |
| V3 | - | - | - | - | - | - | - |
| V8 | - | - | - | - | - | - | - |

*Source*: De Lange (2017).

The analysis of the paired *t*-test of the learners in the control and experimental groups yielded *d* = 0.15 and *d* = 0.14, respectively. These *d*-values or effect sizes indicate a small degree of practical significance with regard to the participating learners' self-directedness in learning after the implementation of CL as teaching–learning strategy. Cohen's (1990) measure suggests that a value <0.2 indicates a small practical significance. It is significant to note that the *d*-values of the control and experimental groups are basically the same, implying that the intervention was not successful. Petersen and Mentz (2016:50) and Petersen (2018) found similar results in their studies when the analysis of the paired *t*-test indicated that no practically significant differences were obtained between the pre-test and post-test after a CL intervention. This might be because the learners scored their own perceptions higher with the pre-test based on their limited knowledge about SDL and CL at the time. However, we can accept that the learners learnt more about SDL and CL during the intervention and therefore scored their own perceptions lower or the same in the post-test. After using Saldaña's (2009) coding system for analysing the learners' and teachers' interviews, four emerging themes were identified. These themes were also used to describe four of the seven factors that resulted from the factor analysis. The four themes are described below, as well as some direct quotes from the learner interviews, which support the findings. Please note that all quotations are presented verbatim and unedited.

## The learners can take responsibility for their own learning

During the factor analysis of the quantitative data, an underlying theme (learners taking responsibility for their own learning) was identified among certain questions of the learners' questionnaire, all of which relate to learners' responsibility for their own learning. The questions involved are as follows:

- Question 1: I identify my own learning needs.
- Question 2: I am able to stay self-motivated.

- Question 7: I can set and plan my own learning goals.
- Question 9: I am responsible for my own learning.

The effect size (*d*-value) for this factor is 0.22, indicating a small practically significant difference between the pre- and post-tests. This was an indication that the intervention was not successful. However, if we look at the finding, based on the qualitative data, it clearly indicates that the intervention did contribute to developing the SDL skill where learners can take responsibility of their own learning. The findings showed that some of the participating Grade 10 Life Sciences learners preferred to research a topic themselves before explaining it and that they did research on unfamiliar content, as supported by the following quotes: 'I'd rather read first and then try it by myself' and 'I want to experience something first on my own and then I'll ask'. These statements serve as indications that learners can learn independently. One of the learners believed, 'there is always a way to grow in learning'. The findings also showed that some of the learners themselves identified resources to meet their learning needs without being instructed by the teacher. If they did not understand the content, they would have taken the initiative to consult either the internet or their peers. This finding is supported by the following statement, 'I read some more about unknown work, asked ma'am and looked on the internet for some of the stuff'. In the interviews with the learners, it appeared that learners believed that their ability to work independently and that their independency had increased, which may indicate that they can take responsibility for their own learning. From the interviews and reflection journals of the teachers, it also appeared that learners developed in their ability to take responsibility for their own learning. 'Every learner worked well and took responsibility for own work' and '[*s*]*o ek dink die kinders het verder bietjie begin selfstandigheid kry*...' [So I think the kids started to gain some independence] (Teacher, undisclosed gender, date unknown). Taking ownership of one's own learning is regarded as an important characteristic of a self-directed learner (Knowles 1975). It appears from the discussion above that students indeed benefitted from the CL environment and that learning in such an environment influenced their self-directedness in learning in terms of taking responsibility for their own learning. We can therefor argue that the CL intervention was applied as an effective scaffold, which resulted in the learners taking ownership of their learning, within their ZPD.

## The learners can identify their own learning strategies and challenges

During the factor analysis of the quantitative data, an underlying theme (learners can identify their own learning strategies and challenges) was identified from among certain questions of the learners' questionnaire, namely:

- Question 4: I find that both success and failure inspire me to further learning.
- Question 5: I see problems as challenges.
- Question 6: I am not going to stop learning due to difficulties I am experiencing.
- Question 10: I am able to choose the best method for my own learning.

The effect size for this factor was 0.17, signifying a small practically significant difference between the pre- and post-tests. In contrast, the qualitative results indicate that the learners perceived that there was a difference after the intervention because they were now more aware of how to identify their own learning strategies. In the interviews conducted with the learners, it appeared that learners could use research as a strategy and that they could identify resources needed to complete a task. The following quotes from learners' interviews provide evidence for this finding. One student stated, 'I knew where to go, the information is in the textbooks and I can go on the internet because I have a phone'. Another learner remarked, 'if you can't find one resource then you go and find other resources'. Yet another learner said:

> 'I knew that I had to find some things, to look and read and do research to finish the assignment … if you can't find one resource then you go and find other resources'. (Teacher, undisclosed gender, date unknown)

It was the teachers' experience also that learners could found suitable resources to construct new knowledge. Some quotes from teachers' reflection journals supported the finding, '[*l*] *eerders kry inligting vanaf verskeie bronne'* [Learners get information from various sources] (Teacher, undisclosed gender, date unknown), and '[s]ome learners struggle to get more information from libraries or internet' (Teacher, undisclosed gender, date unknown), while yet another learner said, '[teachers] bring more books on laptop to school for more information for kids who don't have access to internet' (Teacher, undisclosed gender, date unknown). The qualitative findings, as mentioned above, confirm that learners seem to know how to use resources to meet their learning needs, as well as using existing knowledge to understand difficult content. Learning scaffolded in a CL environment, within the learners ZPD, can therefore contribute to the development of learners' SDL skills in order for them to become more self-directed in their learning with regard to identifying their own strategies and challenges.

## Learners can self-monitor their own learning

During the factor analysis of the quantitative data, a third underlying theme (learners can self-monitor their own learning) was identified among certain questions in the learners' questionnaire, namely:

- Question 11: I succeed in planning and managing my own learning time.
- Question 12: I know how to find resources for my learning.
- Question 15: I can monitor my learning progress myself.

The effect size for this factor was 0.01, which indicates a very small to no practically significant difference between the pre- and post-tests. Based on the effect size, it seems that the CL intervention had no effect on the learners' self-directedness in learning. By contrast, the qualitative results indicate that the learners experienced a difference after the intervention with regard to their ability to self-monitor their own learning. From the learner interviews, it appeared that learners monitored their own learning by identifying and addressing the learning needs needed to do the task. An example of this finding is that learners divided the work amongst themselves in their groups to manage their time more effectively, while others divided the work for themselves to complete the task or assignment on time. 'I noticed I need help in some things, some things I know and some things I don't know'. 'I looked for key words in everything that I do, then I research everything'. It appeared that the learners also had a sense of the role that time plays for them to complete a task:

> 'I actually made a plan how to achieve that [*goals*]. I decided at a specific time we are going to study a topic, certain topics and at another time another topic'. (Learner, undisclosed gender, date unknown)

> 'I learnt to manage my time and how to manage my time, when to study and do my homework'. (Learner, undisclosed gender, date unknown)

In accordance with the latter statements, the teachers' interviews indicate that some learners found the work interesting and exciting while learning on their own to complete the assignment. This teacher commented:

> '*[M]y mond het oopgehang oor enkele leerders wat regtig leiding geneem het … want hulle weet watter verskillende maniere hulle [leerders] kan gebruik om inligting te kry en dat hulle nog meer op hulself kan staatmaak*'. [I was stunned by some learners who really took the lead … because they know the different ways they (*learners*) could use to get information and that they can rely even more on themselves.] (Teacher, undisclosed gender, date unknown)

Teachers are also cognisant of the time spent during CL lessons, and they are worried that the available time might be insufficient. '*Die tyd het vir my bietjie langer gevat*' [This time it took me a bit longer] (Teacher, undisclosed gender, date unknown). Here, the teacher refers to the time it took to complete the entire lesson. This theme elaborated on whether learners could monitor and manage their learning themselves. The qualitative findings mentioned above confirm that learners could monitor – to some extent – their own learning and use appropriate techniques to manage the learning process effectively. If learners can self-monitor themselves, it is an indication that they do at least have some metacognitive abilities, evident of a self-directed learner. Although the learners metacognitive abilities were only developed to some extent, we believe that the way the CL methods was scaffolded within their ZPD indeed contribute to that development.

## Learners acknowledge the value of learning with others in the group

During the factor analysis of the quantitative data, another underlying theme (learners acknowledge the value of learning with others in the group) was identified among certain questions of the learners' questionnaire, namely:

- Question 13: I am able to connect new knowledge to my own personal experiences.
- Question 17: My interaction with others helps me to plan for further learning.
- Question 18: I intend to learn more about other cultures and languages that I encounter regularly.

The effect size for this factor was 0.07, indicating a small practically significant difference between the pre- and post-tests. By contrast, the qualitative results indicated that the learners experienced a difference after the intervention with regard to learning with and from group members. The interviews conducted with the learners indicated that the learners described the CL experience as an opportunity to learn from one another, to compare answers and to discuss concepts confidently with their peers. '[w]e tell each other more about the lesson that we were taught that day. It's easier to talk to my friend about work' (Learner, undisclosed gender, date unknown). Another comment made by a learner was 'working together gives us a chance to see how far we understand the work' (Learner, undisclosed gender, date unknown). Another learner stated, 'we helped each other and eventually compared our answers to see whose is the most accurate' (Learner, undisclosed gender, date unknown). There were also learners who did not like to work in groups, but rather chose to work alone. 'Not really ma'am, because I don't like group work, I prefer doing it on my own' (Learner, undisclosed gender, date unknown). Another learner mentioned that even though she had a dislike in group work, she recognised the value during the learning process, 'I don't like group work, but it helps' (Learner, undisclosed gender, date unknown). Learning cooperatively also adds value to the participating learners' communication skills. One of the learners remarked, '[t]alk about it. I don't like writing so when I talk to a person then I feel the connection better than when I write it' (Learner, undisclosed gender, date unknown), and another learner said, 'I learnt how to communicate with people to help you and them how to achieve your goal' (Learner, undisclosed gender, date unknown), and yet another replied, '[*d*]*ie groepswerk was vir my baie lekker gewees, net om met mense te praat en hul opinies te hoor*' [t]he group work has been great for me, just talking to people and hearing their opinions] (Learner, undisclosed gender, date unknown). The corresponding construct of the questionnaire was aimed at determining whether learners work together and learn from one another or not. The qualitative findings – as mentioned above – confirmed that learners do, to a large extent, consider collaboration with their peers useful in learning from each other. The value that CL may bring to the learning process can be best encapsulated in a comment made by a second-year student, from a previous study, 'CL does not reduce the burden, but makes it more manageable to do' (Petersen & Mentz 2016:58). In the interviews conducted with the teachers, the findings showed that learners more easily understand their peer group explanations about subject content than the explanations from their teachers. The teachers' reflection journals supported the latter statement by stating that the learners learnt from each other by explaining the content to each other – '[l]earners were learning from each other – some explained the work better [than the teacher]' (Teacher, undisclosed gender, date unknown).

In short, the themes indicated that the participating Grade 10 Life Sciences learners believed that the CL lessons developed their SDL skills. Hmelo-Silver, Duncan, and Chinn (2007) describe scaffolding as the type of support given to students during teaching–learning events to help them make sense of managing their own learning and encourage them to articulate their thoughts and to reflect on them continuously. In terms of the ZPD, we argue that the implementation of CL methods as scaffolds was effectively done by the teacher (and more knowledgeable peers) to support the learners to develop their SDL skills as reported by themselves (see Figure 9.1). We therefore conclude that the CL intervention did indeed contribute in taking learners from a lower level of self-directedness to a higher level of self-directedness. The findings of this study are in line with Strods' (2010) study as well as with the findings reported by Petersen and Mentz (2016), which also revealed an increase in the respondents' self-directed learner readiness after a CL intervention.

## Conclusion

In the introduction, the authors described how Marwala (Chauke 2018) argues that jobs with a 'human touch' are going to survive the 4IR and therefore the need that our citizenry has more human-centred characteristics to persist the challenges posed by the 4IR. Based on the findings of this study, where participating Life Sciences learners believed that their SDL skills were developed, we believe that the implementation of learner-centred approaches to teaching–learning, such as CL, in all education sectors, could contribute to the development of 'human skills' to prepare school learners for the employment and tertiary sectors and contribute towards their scientific literacy and lifelong learning skills. Examples of such 'human skills' fostered in a cooperative teaching–learning environment are better communication and listening skills, working effectively as part of a group to achieve a common goal and being able to reflect on the task at hand. All educators in all education institutions should be motivated and encouraged to be innovative in implementing and designing new methods in this regard.

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Chapter 10

# A contextual consideration of parental involvement in homework to develop self-regulated learning

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## Abstract

The poor academic results in many schools are attributed to, amongst others, a lack of parental involvement. Parents are expected to be involved in their children's schoolwork, assisting

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their development into self-regulated learners and ultimately into self-directed individuals. Self-directed learning is a broad macro-level construct, which includes SRL as a narrower construct. Parental involvement in homework can encourage learners to self-regulate their own learning and increase pass rates. Parenting styles and contextual factors, however, influence parents' involvement in their children's homework to develop SRL skills. This research was conducted in three primary and two secondary South African schools. Eight purposively selected parents from the Eastern Cape Province participated. This qualitative case study was intended to provide food for thought about the uniqueness and challenges of different parental styles and involvement practices in homework. Data were collected through semi-structured interviews. Findings indicate that parental involvement practices with children's homework are affected by different factors. Schools should provide homework policies to guide parents. Parents should be informed about curriculum changes for them to give appropriate assistance with homework. Training for lower quintile school teachers should be offered to empower them to guide parents in the SRL development of their children.

**Keywords:** Self-regulated learning; Self-directed learning; Parental involvement; Parental modelling; Homework.

## ■ Introduction

The South African education sectors are facing education crises in that they are struggling to provide quality education. These education crises manifest, amongst others, through high dropout and failure rates in schools, poor infrastructure, lack of educational resources, teachers' inadequate pedagogical content knowledge, teacher and learner absenteeism and a lack of parental support (National Development Plan 2030). Township and rural schools are notorious for the above-mentioned adversities. Consequently, these schools are underperforming and failing to equip learners with the required knowledge, skills and values to function effectively in the 21st century (Spaull 2013:59).

## Problem statement

To manage the education crisis, the South African National Government launched the National Development Plan (NDP). The NDP aims, amongst others, to build the South African society through the improvement of the quality of public services, which include the education sector (National Development Plan 2030). Likewise, the Department of Basic Education implemented the 2030 Action Plan and the Annual National Assessments, which has since been discontinued (National Planning Commission 2012). However, Nkosi (2016) reported that about 90% of South African learners in Grades 3, 6 and 9 achieve less than 50% in the second Annual National Assessments in literacy, Mathematics and science. In comparison with international learners South African learners performed dismally in TIMSS as well as the Progress in International Reading Literacy Study (PIRLS). Their poor performance was evident in Mathematics, science and literacy (Mlachila & Moeletsi 2019:5). From these rankings it can be deduced that despite these efforts, South African schools' performance remains substandard and that learners demonstrate learning deficiencies and education backlogs. Modisaotsile (2012:6) and Mlachila and Moeletsi (2019:28) attribute the poor academic results in schools, amongst others, to a lack of parental involvement.

We assume that if parental involvement is redirected to guide parents on how to develop SRL skills, problems with high failure rates and drop out can be alleviated and lifelong learning will be enhanced (Avvisati et al. 2013:32; Martinez-Pons 2002). Learners need to be prepared for lifelong learning and much of this learning must be self-initiated and self-directed (Martinez-Ponz 2002:126). The development of SRL skills is therefore especially relevant for the objectives of the educational development plans of South Africa. According to Mays, Grosser and De Jager (2012:445) parents can play a vital role in their children's homework. These authors view homework as home-based learning, which is an extension and fundamental part of class-based teaching. Moreover, the vital role of parents in the development of the children's SRL skills in homework and academic learning is globally confirmed (Avvisati et al. 2013; Martinez-Pons 2002; Pino-Pasternak, Whitebread & Tolmie 2010). However, there are variations in levels of parental involvement in children's learning at home and at school is influenced by family socio-economic status (SES), which cannot be ignored. Malebese (2013) found that not all parents are aware of their influence on the education of their children and erroneously believe that it is the task of only the school to educate their children.

Against this background the researchers decided to explore how parental involvement in learners' homework and academic tasks influence the development of SRL skills in learners.

## Research questions

The following primary research question emerged: what role does parental involvement in homework play in the development of SRL skills in learners in lower primary and secondary quintile schools?

Three secondary questions derived from the primary question:

1. How do the parenting styles influence the development of SRL skills?
2. Which SRL skills do parents in schools develop in their children?
3. Which contextual factors obstruct or promote parental involvement to develop SRL skills in learners?

# Theoretical and conceptual framework

This research will draw on the frameworks of Baumrind (1991) and Pomerantz, Moorman and Litwack (2007), literature on parental involvement and the SRL model of Zimmerman and Moylan (2009) to conceptualise the role parental involvement in homework plays in developing SRL skills. The model of Zimmerman and Moylan (2009) illustrates the SRL skills that parents can develop with their involvement in homework.

## Self-directed and self-regulated learning

Self-regulated learning refers to the 'proactive, cyclical processes in which an individual is metacognitive, motivationally and behaviourally active' in his or her own problem-solving processes to attain academic success and general functioning in life (Zimmerman 1989:329). The ultimate aim of developing SRL is to develop self-directed individuals. Based on Knowles' (1975) definition a self-directed individual is able, ready and willing to prepare, execute and complete learning independently by formulating their own learning goals, finding suitable resources for learning and monitoring his or her learning activities (Jossberger et al. 2010:419).

Both definitions of SDL and SRL imply active learning and learner control. The degree of control the learner has according to Loyens, Magda and Rikers (2008:418) 'specifically at the beginning of the learning process when the learning task is defined', differs in SDL and SRL. In SDL, the learning task and learning trajectory are always defined by the learner, whereas in SRL, the learning tasks, for example homework activities, can be generated by the teacher. Self-regulated learning is practised in a formal curriculum of an institution and is the first step in learning to self-direct one's learning. Our view of SDL and SRL is supported by Long (2000), Loyens et al. (2008:418) and Jossberger et al. (2010:410) who perceive SDL as a broader macro-level construct, which includes SRL as a narrower construct. Loyens et al. (2008:418) explain that SDL requires SRL: 'one needs self-regulation to become a capable self-directed learner'. In this sense, SDL can contain SRL, but the opposite does not hold.

Because the research context includes homework and the learning goals of homework are determined by a formal curriculum and teachers, we decided to explore the development of SRL skills.

## Zimmerman and Moylan's (2009) model of self-regulated learning

Based on the social cognitive theory, Zimmerman and Moylan (2009) have proposed a cyclical model that illustrates the different processes and sub-processes (SRL skills) self-regulated learners demonstrate. This model consists of the forethought, volitional or control and the self-reaction phase.

The forethought phase entails all the processes and sub-processes self-regulated learners engage in before they start a task. Task analysis is the first SRL skill in the Zimmerman and Moylan's (2009) model of SRL. During task analysis I will set goals and plan strategically how, when, where and with whom to complete the task (Zimmerman 2013:143). When setting goals these learners set proximal, distant, specific and challenging goals that direct them in what they want to achieve. Their goals influence their motivational and self-efficacy beliefs, effort, persistence, task interest and value, the goal orientation and the outcome expectations the academic tasks offer (Zimmerman, Schunk & DiBennedetto 2015:90). For more proximal goals, self-regulated learners will plan their task strategies, their time needed to complete the tasks and the resources required (Zimmerman 2013:143). Learners who have positive outcome expectations of their academic tasks tend to be more committed, to exhibit more task interest and to understand the value of what they learn at school. Typically, these learners demonstrate mastery goal orientations and more SRL behaviour. Such learners are focused on learning and mastering the academic tasks according to self-set standards of self-improvement. In contrast, individuals with performance goal orientations work only to achieve extrinsic goals and focus on out-besting others (Schunk, Pintrich & Meece 2014:213).

The volitional phase encompasses all the SRL skills learners demonstrate while they are doing the task. In this phase, learners' motivational and self-efficacy beliefs causally influence the choice of task strategies, academic time management and self-monitoring they demonstrate when they are completing tasks (Zimmerman & Moylan 2009:302). They will structure their learning environments to avoid distractions to ease their concentration and attention focusing while doing academic tasks. They seek help from knowledgeable others to assist them with resources or comprehension of instructions, if necessary. They do self-observation of their progress and comprehension towards completing the task. They do not rely on external help and will first try to solve problems themselves before they seek help. Therefore, they are instructing themselves through reflection, reading, rereading and applying and adapting task strategies. Skillful self-regulated learners also self-record strategies that enable their progress (Zimmerman & Moylan 2009:303).

In the self-reaction phase, learners judge their own performance and self-evaluate the attainment of their goals against a standard set by teachers or themselves. Self-reaction refers to 'feelings of satisfaction or dissatisfaction stemming from evaluative judgement of one's performance' (Zimmerman et al. 2015:88). If learners attribute poor academic performance to uncontrollable, external causes such as teachers or lack of academic ability, they will become demotivated to learn (Zimmerman & Moylan 2009:304). Self-satisfaction on the other hand results in higher self-efficacy beliefs, better planning, goalsetting and effort with future tasks.

## Parental modelling

Learners can learn new academic skills and behaviours by observing models such as peers, teachers and parents. Parents can thus act as models firstly to consolidate SRL skills learners learn in schools and secondly to further develop SRL skills by demonstrating their own self-directed behaviour and skills which learners can apply in homework and other academic activities. However, to effectively emulate parents' self-directed behaviour, learners need guidance, support, feedback and verbal encouragement when demonstrating these behaviours in homework and other academic tasks. Martinez-Pons (2002:130) offers the following examples of parental modelling. Parents turning off television sets to help their children with homework are modelling to their children how to structure and control their learning environments so that they can focus without distractions. Such parental modelling also conveys the intrinsic value placed upon concentration and giving your best to do well in home-based and school tasks. Martinez-Pons (2002:128) further suggests four parental modelling activities to develop self-regulatory behaviour in children, firstly, through the facilitation of indirect forms of guidance, such as structuring a conducive learning environment for one's children, as well as direct forms of guidance, such as providing motoric support. Secondly, he suggests parental encouragement and rewards when children demonstrated self-regulated behaviour such as awareness of their responsibility for completing their homework. Lastly, parents can model SRL characteristics such as motivation, goal setting and persistence with their involvement in homework. Their disposition modelling of SRL characteristics, where their own positive attitudes and dispositions, values and practices of SRL are displayed, offers learners a vital exposure to examples of SRL (Salisu & Ransom 2014:55).

## Parental styles

Baumrind's conceptualisation of parenting styles consists of two dimensions' demandingness and responsiveness. Demandingness refers to the level to which parents supervised and show control towards their children and responsiveness refers to the extent to which parents show warmth, acceptance and involvement towards their children (Baumrind 1991:61–62). From the two dimensions, four types of parenting styles emerged, that is authoritative, authoritarian, permissive and neglectful parental styles (Baumrind 1991). We will only discuss the two parenting styles and dimensions identified in this research.

Building on Baumrind's (1991) conceptualisation of parenting styles, Pomerantz et al. (2007:382) distinguish between autonomy supportive practices of parents and controlling practices of parents. Authority supportive parental involvement is similar to an authoritative parenting style (Silinskas & Kikas 2019:19).

This parenting style is evident when parents are offering emotional and motivational support, scaffolding and encouraging children to take initiative and responsibility with academic tasks (Vasquez et al. 2016:606). Autonomy supportive parents exhibit low psychological control and high emotional support by their involvement that increases their children's sense of competence in autonomy and persistence in learning (Pomerantz et al. 2007:383).

Jittaseno and Varma (2017:49) note that authoritative parenting styles serve as an important factor of self-efficacy, which are related to academic goals, adaptive help-seeking and motivation. Authoritative parents foster SRL in children by setting boundaries, having open communication about the reasons for their decisions and encouraging independent decision-making (Jittaseno & Varma (2017:53). Parents' own engagement in activities, as well as their verbal positive feedback and praise, increases their children's self-efficacy beliefs, task interest and intrinsic value in related activities, which in turn increases SRL (Jittaseno & Varma 2017:54).

Authoritarian parents are controlling. They have hostile and critical dispositions about homework. Their psychological control is demonstrated when children's ideas are criticised resulting in feelings of worthlessness and decreased self-confidence. Their behavioural control entails monitoring and supervision and exerts punishment and pressure, when homework is not completed (Pathak, Sinha & Tiwari 2016:130). Authoritarian control undermines the development of SRL (Jittaseno & Varma 2017; Silinskas et al. 2015); however, Pathak et al. (2016:130) state that parental control is culture specific and in some cases it can prevent poor academic performance. Jittaseno and Varma (2017:56) for example found that many children of authoritarian parents know that their parents' actions are well intended; therefore, they choose to study hard to avoid parent–child conflict. As these children grow older, they tend to internalise the values of their authoritarian parents and may discover subject areas that they find rewarding and interesting. Jittaseno and

Varma (2017:56) concluded that authoritarian parents with their controlling behaviour may thus indirectly influence SRL through intrinsic value in the long run.

The third dimension in the framework of Pomerantz et al. (2007:382) is process versus person focus. The process dimension focusses on parents' involvement to let his or her child experience the fun and excitement in learning, whereas the person dimension focusses on innate abilities of children. The fourth dimension is positive versus negative affect and beliefs about children's potential. The fourth dimension comprises positive emotional involvement such as acknowledging their children's tiredness, fear or excitement about homework. Negative emotions include, amongst others, no interest or involvement in school activities.

## Environmental, personal and behavioural determinants that influence parental involvement

The social-cognitive perspective maintains that SRL is influenced by 'personal, environmental, and behavioural determinants which operates and interrelate with one another' (Schunk et al. 2014:145). In this model of reciprocality, changes in any one of the three determinants has a snowball effect on the other two determinants. Personal determinants represent, particularly in this study, participants' parenting styles, educational levels, their own SDL skills along with beliefs, and other motivational forces that enable them to develop SRL skills in their children (cf. Geduld 2019:60–78). Environmental determinants in this study include for example, the SES of parents and the community, education contexts of low school quintiles and directives from the Department of Education, all of which contribute to the social and physical learning environment of participants' children. Behavioural determinants are exemplified by participants' level of involvement with homework to develop their children's SRL skills (cf. Geduld 2019:60–78).

Harris and Robinson (2016:189) maintain that the SES of parents influences their abilities to convey the importance of education to their children and to create and maintain an environment or life space in which learning can be maximised. Even though parents across different races express the value of education to their children, their SES affect their level of involvement in their children's schooling (Harris & Robinson 2016:189).

Parental involvement in lower socio-economic communities is commonly influenced by a lack of financial resources to provide for homework activities, limited reading and writing skills, lack of effective language proficiency to converse with teachers and inferior feelings caused by their inadequate academic knowledge and skill (Parmaswar 2014:57). Even though they might want to assist their children they lack networks and relationships in their society that could enable them to seek help. In lower socio-economic situations, parents commonly lack the time to assist with homework because of work or family responsibilities (Parmaswar 2014:58). Likewise, many affluent parents have minimal direct involvement in their children's school work because of their demanding careers and busy lives. Van Voorhis (2011:222) noted that many parents experience homework as time consuming and a major cause of stress in their households because of the demands of time and whole family involvement. Besides the cost of their time and energy, parental involvement is difficult when teachers fail to explain the assignment to learners in class, when homework activities do not relate to classwork, or when learners are unsure about how to complete it (Van Voorhis 2011:224).

Parents with lower levels of education do not engage in critical thinking in common everyday discussions with their children (Harris & Robinson 2016:189). Such discussions create a conducive social environment that fosters academic success. Many of these parents cannot give cognitive stimulation and support like the parents with higher educational backgrounds (Hyde et al.

2006:137). However, many socio-economically, disadvantaged parents offer emotional and motivational support to their children.

Cooper, Lindsay and Nye (2000:464) found that parents from poorer families are more controlling, showed less autonomy support and interfered more in their children's homework. A possible reason might be that they want their children to have better lives through achieving academically. Many controlling parents may experience frustration when they lack knowledge in subjects and are ill-prepared to assist their children with homework. These parents might become so excessively involved to the extent that they complete the homework assignments themselves (Hyde et al. 2006:137).

The home conditions of these parents are many times overcrowded, leaving learners with little space to do homework; however, many parents try to create a conducive space for homework and a decent home environment to counteract negative influences from their living environments in poor neighbourhoods (Harris & Robinson 2016:189). Their choices of schools are limited and determined by the affordability; therefore, their children attend the closest school to home, irrespective of the school's reputation (Parmaswar 2014:57).

## Methodology

This research is within an interpretivist philosophical orientation. A qualitative research design was used in this research based on the philosophical assumptions and potential it offers to understand parents' individual parenting styles and their experiences and meanings of how they develop SRL skills with their parental involvement in their children's homework. The case study, as a strategy of inquiry method, is suitable for this research because of its investigative nature to examine lived experiences in a contemporary phenomenon in a real-life situation and the multiple wealth of details it can give (Maree 2016:77). In this research, the lower quintile primary and secondary school participants will be a case.

## Sampling strategies

This research was conducted in the Eastern Cape Province, South Africa. This research is part of a bigger project with the Eastern Province and the North West Province. However, this chapter only reports on the Eastern Cape sample. The sample consisted of four primary school and four secondary school parents with children in primary or secondary quintile 2 or 3 schools. The primary school participants were two males and two females. All four participants from the secondary schools were female. The lower school quintiles and participants were purposively selected because we wanted to explore the contextual factors that influence parental involvement to develop SRL skills.

According to Spaull and Kotze (2015:21) higher academic results are reported from learners in quintile 4 and 5 schools, compared with the lower quintile schools (1–3) who perform at or near the bottom in national and international tests. The quintile 4 and 5 schools in comparison with the lower quintile schools, who serve the 75% poorer learners in South Africa, have better infrastructure, resources and mostly parents from higher SES (Spaull 2013:436). Against the background of these differences, we wanted to explore what role parental involvement in homework plays in the development of SRL in learners.

Ethical clearance was obtained from the university where the two authors are working. We abided by all ethical aspects of conducting research, such as obtaining permission from the Department of Basic Education and informed consent from the participants, respecting and upholding confidentiality and anonymity.

To enhance reliability and internal validity, we used appropriate sampling techniques and built a trail of evidence (interview schedules, audio recordings with raw data, transcribed interview data and data reduction documents). To enhance validity, sufficient time was provided for all participants to share their views during individual interview sessions. We made use of member-checking by sharing the data with participants and offering a detailed description of the data (Creswell & Creswell 2018:314). Participants' comments are identified by their participant number, the type of school (primary or secondary) where their children are enrolled and their occupation (e.g. P1S P1 stands for Participant 1 of a Secondary school).

## Data collection

Semi-structured, individual interviews were the most appropriate method to collect data to gather a deeper understanding of contextual influences on parents' involvement in homework to develop SRL skills. Semi-structured individual interviews therefore offered us insights, which would not have been obtained from purely quantitative data collection methods such as questionnaires. Parental involvement can be a sensitive topic because it is influenced by parents' education levels, their previous experiences with schools and their socio-economic situations amongst other influences. Not all participants might have had the skills to respond in a questionnaire or to talk about certain issues in a focus group interview; therefore, we viewed semi-structured interviews as an appropriate method to collect data.

One semi-structured, face-to-face interview was conducted on a date and time convenient for participants. The interviews were voice recorded with participants' permission. The length of the interviews was approximately 30 min – 40 min. The questions in the semi-structured interview were: How do you assist your child with homework? What makes it easy for you to assist your child with homework? What makes it difficult for you to assist your child with homework? The aim of the interviews was, firstly, to explore their types of parental involvement and secondly how participants' parental involvement supports the development of SRL in their children. Thirdly, the interview data were used to explore contextual factors that obstruct or support parental practices of parents with learners in lower quintile schools.

In the next section, the data analysis and interpretation of data will be discussed.

## Data analysis and discussion

The data from the semi-structured interviews were analysed, utilising the content analysis and a thematic approach (Maree 2016:111). The researchers used an *a priori* and open coding process. The predetermined themes were created from the dimensions of parental involvement in homework according to the framework of Pomerantz et al. (2007), as well as from other literature on parental practices of homework. The participants' responses relating to parenting styles and the development of SRL were categorised according to the themes identified from the literature. Likewise, categories or responses that refer or relate to the SRL skills in Zimmerman and Moylan's (2009) model were identified. Categories or responses that refer to contextual influences that obstruct or promote the development of SRL were identified and placed under predetermined sub-themes.

Three main themes emerged:

- Theme 1 – parental styles and the influences on motivation, intrinsic task value and autonomy
- Theme 2 – SRL skills developed
- Theme 3 – contextual factors influence SRL skills.

Sub-themes were created from each theme.

### Theme 1: Parenting styles and the influences on motivation, intrinsic task value and autonomy

The analysis of the primary school participants' parental involvement in homework indicates that their parenting styles and their dimensions of parenting can be described as authoritative, autonomy-supporting, responsive and process oriented (Pomerantz et al. 2007:385; Silinskas & Kikas 2019:19). Their responses indicated that they give high emotional and motivational support (Silinskas & Kikas 2019:19) for example: 'I make learning fun, I tell them stories and interact with them to teach them the deeper stuff…' (P1P, primary school parent, correctional service officer). They furthermore ensure their children's basic needs are met before they do homework: 'I tell her to first eat, and relax after school then do homework' (P3P, primary school parent, unemployed).

They furthermore motivate their children and develop many SRL skills through their cognitive support and modelling of SRL skills (Eleftheria & Cortinaz 2014:383). Their authoritative, autonomy-supporting and responsive parenting styles are evident in the manner that they develop SRL skills, particularly in the forethought phase as well as in the other SRL phases (see discussion in theme 2 below).

The parenting styles of the four secondary school participants (P1S, P2S, P4S) can be classified as authoritarian with controlling dimensions (Baumrind 1991; Pomerantz et al. 2007:382). These parenting styles inhibit the development of SRL skills (Jittaseno & Varma 2017). The responses below are indicative of their authoritarian, controlling and interfering practices. P1S (secondary school parent, shop assistant), detailed: 'I get very cross and punish my children if their homework is not done. We have a high standard otherwise she will not achieve'. P2S elucidated:

> 'He does not make it easy for me. I have to force myself on him, but he likes me to take control. If a project even a group project is not good enough for me, I do it over for them. He even calls me control freak'. (P2S, secondary school parent, teacher)

In the same vein, P3S (secondary school parent, volunteer food handler) described how '[h]e cannot take responsibility. I must pressure him all the time and help him'.

The parenting style identified in P4S (secondary school parent, volunteer food handler), seemed to have elements of different parenting styles described by Baumrind (1991) and Smith et al. (2017:41). Firstly, the participant expressed low demandingness, warmth and acceptance stemming from her child's eye sight and concentration problems: 'I understand she has learning problems that is why I don't force her…'. It seems this participants' warmth and responsiveness is caused by her sympathy for her child's eye sight and concentration problems. She therefore takes over all the responsibility for the child's work to compensate for the learning challenges the child has. However, contradictory to her previous response, P4S also demonstrates controlling practices, which negate the development of SRL skills (Silinskas et al. 2015): 'She must just pass with distinctions to become a nurse to follow my dream I could not do…'.

## Theme 2: Self-regulated learning skills developed

### Sub-theme 2.1: Self-regulated learning skills developed in the forethought phase

From the primary school participants' responses, it can be concluded that they encourage and model most of the SRL skills in the forethought phase; some to a lesser and others to a greater extent. Only one participant mentioned the development of task analysis and strategic planning as SRL skills when asked what he tells his child before he starts with homework. P4P said:

> 'I teach, first read the instructions, see what you will need. Plan how you will answer the questions and also think how much time it will take you so that you do not waste time on only one question'. (P4P, primary school parent, administrative clerk)

With regard to goal setting all participants seemed focused on their children's distant career goals and whether the child's interests and personalities are suitable for their distant goals. P1P explained:

> 'We look at our child's interests and potential. He wants to be an engineer and I agree he should be an engineer or work in the navy. He gets so excited when we talk about it'. (P1P, primary school parent, correctional service officer)

P4P (primary school parent, administrative clerk) was less specific about the goals his child pursues: 'I think he is more technical and not so good academically. I want him to stand out in life, to be a success, a professional’. Participants P1P and P4P are involved in abstract and direct ways by giving their children perspective on life, instilling an academic motivation and by setting high academic and career expectations (Harris & Robinson 2016:192).

They also emphasised the importance of effort and persistence when academic goals become too difficult for their children to achieve. The examples they made are supported by Zimmerman and Moylan (2009) and Pomerantz et al. (2007:382). P4P (primary school parent, administrative clerk) for instance said: ‘I tell him to never give up, there is a solution for every problem. Just work harder, find help use new ways to do something’. These responses from the authoritative autonomy-supporting participants are supported by Harris and Robinson (2016:189) who state that even though many socio-economically, disadvantaged parents cannot give cognitive stimulation and support, they offer emotional and motivational support to their children.

The building of motivational beliefs, high self-efficacy beliefs, positive outcome expectations and task value and interest and a learning goal orientation mentioned in Zimmerman and Moylan (2009) are evident in the parental involvement of all the primary school participants. In general, they use positive reinforcers (P2P), scaffolding (P4P) and building of mastery goal orientations to develop SRL skills. P1P says he watches interesting programmes, DIY (do it yourself) programmes and YouTube videos with his child to connect what his child learns in school with real life. This type of involvement is beneficial to develop learners’ task value and interest in school work (Jittaseno & Varma 2017; Schunk et al. 2014:231).

In general secondary school participants did not encourage SRL skills, besides distant goalsetting. Their responses regarding their own and their children’s educational goals revealed their parental education expectations or aspirations as well as the values they place on their children’s education (Xu et al. 2010:254).

When the secondary school participants explained how they assist their children with homework, none of their explanations clarified how they develop task analysis skills, strategic planning skills or the skills to set proximal academic goals. Only P1S explains that she communicates openly with her child and encourages her to work hard to achieve her academic goals. According to P1S her child already sets her own proximal goals:

> 'She is competitive; people think it is me but it is she. If she is disappointed in her progress and final results she tears her rapport. She aims for high marks in all test and assignments'. (P1S, secondary school parent, shop assistant)

This is how P1S justified her child's actions, stating that 'Good results are important, where will you get work? Matric means nothing' (P1S, secondary school parent, shop assistant).

The three other secondary school participants have similar views about the aim of education and their parental involvement. Their authoritarian parenting styles were evident in their responses. They clearly expressed their reasons for their doing most of their children's homework that they are capable of doing, or finding people who can do it for their children, namely that their children must achieve good marks and eventually pass Grade 12. All participants are encouraging performance goal orientations in their children by putting the emphasis of school work only to get good results to obtain bursaries and pass Grade 12.

With regard to motivational beliefs the participants' authoritarian parenting styles explained their type of involvement. They perceive themselves as motivating their children when they pressure their children to achieve. The only outcome expectation they instil in their children is to pass Grade 12, to eventually live in a better SES. The following examples demonstrate the type of viewpoints the secondary participants hold: P1S, (secondary school parent, shop assistant) said '[t]hey must pass to get their own jobs and own places. We share rooms now they must get out of this conditions'.

## Sub-theme 2.2: Self-regulated learning skills developed in the volitional in phase

It was remarkable that, irrespective of their socio-economic situations, the primary school low quintile participants demonstrated responsiveness and autonomy-supporting practices to develop various SRL skills in the volitional phase (Pomerantz et al. 2007:384). Miller and Keeler (2017:37) aver that parents with low SES and low educational levels are unfamiliar with homework practices, which makes them unprepared to assist their children. In contrast to Miller and Keeler's (2017:37) findings, the lower quintile primary school parents in this research could coach and guide their children through their involvement with homework.

P1P explained:

> 'I do the difficult parts for him and then he must observe and do the rest. Their workbooks do not have enough space to make notes, so I gave him a book to make his own notes in class that will help him with the homework'. (P1P, primary school parent, correctional service officer)

P2P (primary school parent, entrepreneur) says she taught her child to look for resources himself: 'He seeks help from me and my mom. Sometimes I give him money to go to the Internet café to find information himself'. P4P and P1P said they search for information on the Internet themselves and then tell their children where to look for additional help for example in libraries. P4P said that his child has learnt to take responsibility for his homework and to manage his time while he and his wife are still at work, and 'we can only assist after work with the difficult parts he struggles with' (P4P, primary school parent, administrative clerk).

Metacognitive monitoring for comprehension and progress is closely tied to self-instruction.

Only participant P4P implied the development of metacognitive monitoring:

> 'He must tell me exactly why he does not understand something. I always listen to his ideas and let him explain why he wants to do it in

> a particular way. I ask him many questions to teach him that he must think and change his plans if it is not working'. (P4P, primary school parent, administrative clerk)

From the responses it was evident that the low quintile secondary school participants do not develop most of the SRL skills in the volitional phase through their involvement. Their descriptions of their children's and their own involvement in homework activities clarified possible reasons for the low self-regulation that their children exhibit.

The parental involvement of P1S mostly involves checking whether homework was done and assisting with help seeking to find resources and information for assignments. P1S was the only participant who stated that she teaches her child and her other children to take responsibility for their own learning:

> 'They must do their work on their own. I just check whether it was done and sign their books. My parents never checked on me. I have too many children so it is four sets of homework…'. (P1S, secondary school parent, shop assistant)

She also teaches her child to manage time and to ask extra help with clarification of instructions from teachers.

Participant P3S (secondary school parent, volunteer food handler) also teaches her son to find help form teachers. She, however, takes most of the responsibility with homework, describing how 'I google and find information for him because his English is not so good, and he does not always know how to search for the correct information' (P3S, secondary school parent, volunteer food handler).

The other two participants did not seem to find it problematic that they take over all the responsibility for homework from their children by doing most of the work they are capable of doing with the help of friends and extended family members. The consequences of taking over learners' homework might result in learners not acquiring important SRL skills while doing homework. Examples of these SRL skills are applying different task strategies, focusing attention, structuring their learning environments, self-instruction and metacognitive monitoring.

As already mentioned they are more concerned that their children achieve high continuous assessment marks to pass Grade 12. The following statements exemplify their parental involvement:

P2S, a mother who has a child with learning difficulties, justifies herself:

> 'I want him to get better marks, therefore I am doing work because he has trouble completing it. He does not understand maybe oral exercises he can do. I just want him to pass I don't want him to go to school without homework. As long as he goes to school and pass matric'. (P2S, secondary school parent, teacher)

According to P4S:

> 'They do their homework mostly at school when some teachers are absent and they have free periods. But yes I do the homework; when they do not want to do homework, so I ask my brothers' child to help me. I do not care what the teachers say as long as it is done and she passes…'. (P4S, secondary school parent, volunteer food handler)

With regard to time management P3S says her child, a Grade 10 learner, manages his own time and decides when he wants to do school work. P2S lives with her son in separate accommodation on the premises of the hostel of a secondary school. Although her son did not live in the hostel, he was obliged to obey hostel rules and regulations. She explained that she thought time management skills were developed in her son:

> 'Everything here in the hostel works with a bell, study time, breakfast, lunch, he must just obey the rules. It is good for him, because I do not think he can manage his own time'. (P2S, secondary school parent, teacher)

It can be deduced that the lower quintile secondary school participants are providing more help than their children require. This type of parental involvement is not advantageous for the development of SRL skills. Instead of encouraging task-persistence, strengthening self-efficacy and self-satisfaction based on the attribution of outcomes as the result of personal efforts, these participants indirectly communicate no confidence in their children's abilities (Pino-Pasternak et al. 2010:230).

## ☐ Sub-theme 2.3: Self-regulated learning skills developed in the self-reflection phase

It appears that all primary school participants enquire about teachers' feedback of homework. By showing this interest they convey the message that education is important. To give a report on the teacher's feedback the learners must first interpret, reflect on the feedback and self-evaluate their own work. With the positive teacher's feedback learners are given the opportunity to experience self-satisfaction, which improves their motivation (Zimmerman et al. 2015:88).

P2P (primary school parent, entrepreneur), for example, revealed that she always asks her child to evaluate his own work for completeness and correctness. P3P (primary school parent, unemployed) mentioned that her child gets very excited after positive feedback, which indicates that she experiences self-satisfaction that results in higher self-efficacy beliefs and improved goal setting with future tasks (Jittaseno & Varma 2017; Zimmerman et al. 2015:90). P3P explained that teacher feedback also enables her to evaluate the success and appropriateness of her advice, guidance and provision of resources with homework. With revision exercises and by asking questions before tests, P3P and P4P teach their children how to self-evaluate knowledge and skills. None of the participants mentioned how they develop the other SRL skills in the reflection phase.

In the secondary school participants' explanations of their involvement with homework, only one response of P3S indicated the development of self-evaluation skills. The participant said that she helps her child to write his Afrikaans essays and thereafter she helps him to evaluate his work and shows him where to improve.

No responses were made by P1S with regard to teaching her child to self-evaluate work, to adapt strategies or the value of self-satisfaction after completing homework tasks successfully. P2S (secondary school parent, teacher) explained that she evaluates her son' work, because he has barriers to learning and is unable to do it. She also admitted to improving the homework herself. She explained: 'He has trouble completing homework because he does not understand most of it'. P4S explained that she asks her child to explain the aspects of work that she does not understand. This offers an opportunity for self-evaluation. However, the learner has no benefit, because the participant only uses the information to understand what she must do to help her child who has concentration problems and bad eyesight. P4S (secondary school parent, volunteer food handler) elaborated: 'I understand that she struggles in school that is why I do not force her to do anything. I try my best to do most of the homework for her'. According to Zimmerman (2000:28) learners with barriers to learning find it difficult to self-regulate their learning. Nonetheless, both participants P2S and P4S do not make any effort to teach their children to at least try and take responsibility for their work.

The only response that relates to teaching children to make realistic attributional for their failures came from P3S. She explained that her son blames his poor performance on teachers who do not explain well. She tries to teach him to take responsibility for his own work: 'I told him not to blame the teachers you can find help yourself' (P32, secondary school parent, volunteer food handler).

As already mentioned in the discussion of the forethought phase earlier, their authoritarian parenting styles inhibit the development of SRL skills in the self-reflection phase.

In the next section the last theme will be discussed.

## Theme 3: Contextual factors that influence parental involvement to develop self-regulated learning skills

According to Schoon (2018:3–5) all learning which includes SRL and SDL does not occur in a social vacuum. Structural, societal, cultural and economic conditions shape the situations that individuals encounter and how SDL and SRL are developed. Therefore, parental involvement cannot be understood without considering contextual factors such as the social conditions and person-environment interactions in which it is enacted (Schoon 2018:14).

Contextual factors that were considered in the data analysis include the quintiles of the schools determined by the socio-economic situations of the school communities, educational levels of parents, their homework practices and learners' abilities to self-regulate.

### Sub-theme 3.1: Self-directed characteristics of parents that promote involvement to develop self-regulated learning skills

Participants were asked what makes it easy to assist their children with homework to determine the contextual factors that support parental involvement in homework.

Responses revealed participants' own SDL skills such as communication, help-seeking and persistence enable them to develop SRL skills in their children. Participants from the primary schools indicated that their knowledge gained in secondary schools, the open communication with their children, support from friends and family in their surrounding communities and their own commitment to helping their children succeed makes their parental involvement easy. P1P explained:

> 'I can help them with everything, most subjects. The curriculum changed but where I can still relate I help. I did not study further but I

> was a very good student in high school'. (P1P, primary school parent, correctional service officer)

P2P (primary school parent, entrepreneur) detailed how 'I have good open communication with my child. He does not keep problems to himself and that makes it easy for me to seek help for him'. P3P (primary school parent, unemployed) said, 'my friends around us and their children who are in high school help us a lot'. P4P (primary school parent, administrative clerk) responded, saying 'I will go out of my way to help them. It is important for me to know they enjoy what they do at school'.

Two quintile secondary school participants P1S and P4S said their parental involvement was made easy by their own commitment to help their children to pass Grade 12 as well as the telephonic contact they have with teachers: 'I call the teacher or send her a picture of the parts we do not understand. She will then send a voice message to explain to me' (P2P). Participant P2S (secondary school parent, teacher), a parent of child with barriers to learning, said: 'Nothing makes it easier for me. I want him to get better marks; therefore, I am doing his work. I just want him to pass'. P3S expressed the same reason for her motivation to be involved in homework. Contrary to the beliefs of participants P2S and P3S, their controlling and interfering parental styles demonstrate performance goal orientations that negate learners' autonomy and the development of SRL skills (Cooper et al. 2000:464; Pomerantz et al. 2007:384).

## ☐ Sub-theme 3.2: The influence of environment and personal determinants on parental behaviour to develop self-regulated learning

All participants were asked what makes it difficult to assist their children with homework.

Both primary and secondary school participants lamented over their unpreparedness and inability to assist when homework instructions are unclear or when learners forgot what they were supposed to do for homework (Miller & Keeler 2017:37).

One parent P3P (primary school parent, unemployed) explained: 'I do not understand Mathematics, I do not know what is a rubric, so how can I help her?' When asked why she does not contact the teacher, she elaborated that not all teachers at the specific school want to give their cell phone numbers to parents; they say parents must just do their job too.

A father of a Grade 6 pupil explained that the confusion with homework instructions is worsened by the shortage of textbooks at the lower quintile schools where children are not allowed to take books home. 'My children only bring the homework questions, but no textbook to give me some background. I feel so useless that I cannot help my child' (P4P, primary school parent, administrative clerk).

Another father, P1P, was clearly frustrated with the homework practices at a school. His response encapsulates the views of the other parents from the primary schools:

> 'Well some teachers do not make homework interesting. One teacher of my child is on her cellphone all the time and does not explain clearly to the children. Some teachers give too many projects knowing very well we do not always have money and resources. It is difficult to find things when we get home after six o'clock. Why can't they give learners pictures of good examples so that the child and the parents have a broader idea of what is expected? Teachers do not talk to each other. Many times my children are so tired because there is just too much homework. This cause pressure in our house, because my other children must also get attention, but my wife and I are always busy helping with the projects'. (P1, primary school parent, correctional service officer)

The responses of this participant are all confirmed by Parmaswar's (2014:58) views of environmental determinants that influence parental involvement, discussed above.

Participant P1P even alluded to suggestions that schools provide free resources at a central place for parents and that teachers teach in class the content that will help their children to do the homework alone at home. Participant P4P complained that work done in class is not always preparation for homework.

Two participants' low educational levels seem to be a challenge to provide appropriate academic help (Parmaswar 2014:58). The responses illustrate the influence of personal determinants on participants' behaviour (Schunk et al. 2014). P3P (primary school parent, unemployed) said*:* 'I had to leave school when I was in standard 7 because I got breast cancer'. P2P (primary school parent, entrepreneur) explained why it is difficult to help with homework: 'I got him when I was 14 years old. I left the school now I cannot help him, I learn more from him'. P1P (primary school parent, correctional service officer) who passed Grade 12 said: 'I am not stupid but some workbooks like the Maths book is like a university workbook. I think there are unnecessary difficult methods and explanations'.

The noisy surrounding communities and unstable households where alcohol abuse is rife also pose challenges to some participants who want to ensure a quiet learning environment for their children.

Two participants, P2S and P4S, from secondary schools are challenged by their children who seem to have barriers to learning caused by 'mild dyslexia (P2S), a poor eye sight and concentration problems' (P4S). P1S, a shop assistant, and P4S, a single mother and volunteer food handler at a school, who both passed Grade 12, experience their lack of finance to buy resources, limited time to assist their children and their lack of subject knowledge in 'new' subjects like Tourism and Business Studies as big challenges. She added that insufficient time because of work responsibilities and not having resources at hand, when she needs it, encumber her to assist with homework (Parmaswar 2014:58).

## Conclusions and future directions

This research made a contribution to the current understanding of parental involvement in homework in lower quintile schools. Findings in this research revealed that quality of parental involvement and the extent to which parents develop SRL skills is highly influenced by their unique environmental, personal and behavioural determinants.

## Finding 1: The influence of parenting styles on the development of self-regulated learning skills

The results indicate that the authoritative, autonomy supportive parenting style is most dominant in the lower quintile primary schools (Pomerantz et al. 2007:382; Vasquez et al. 2016:606). This finding is supported by Harris and Robinson (2016:189) who reported that all parents, irrespective of race and SES, show emotional and motivational support and do express the value of education to their children. The parenting styles of the primary school participants support the development of SRL skills such as motivation, self-efficacy beliefs, intrinsic task value and autonomy (Jittaseno & Varma 2017).

On the other hand, the findings revealed that the parenting styles in the secondary schools are authoritarian and controlling. The controlling and interfering type of involvement of secondary school participants refutes the development of SRL skills and rather sends messages of low trust in their children's capabilities to deal with academic requirements.

## Finding 2: Self-regulated learning skills that parents develop in their children

Results show that primary school participants develop and model most of the SRL skills in the forethought phase of Zimmerman and Moylan's (2009) SRL model, some to a lesser and others to a greater extent. Through disposition modelling, scaffolding, verbal persuasions and positive reinforcement all the SRL skills under motivational beliefs are developed (Salisu & Ransom 2014:55). Most of the primary school participants do not develop proximal goal setting and strategic planning skills. Although the secondary school participants perceived themselves to be motivating and supportive in developing SRL skills, they are because of their parenting styles only developing distant goal setting and performance goal orientations towards educational goals.

Only a few SRL skills in the volitional phase are developed by primary school participants through guidance and modelling. The SRL skills are attention focusing, help seeking, time management skills and environment structuring. The development of task strategies and metacognitive monitoring through scaffolding was only mentioned by one participant, which allows the assumption that these SRL skills are not developed by most of the primary school participants. Volitional phase skills, imagery, self-instruction, self-experimentation or self-recording, are not developed. It is concluded that the lower quintile secondary school participants are not developing any of the SRL skills in the volitional phase of Zimmerman and Moylan's (2009) model.

Both primary and secondary school participants lack knowledge and skills to develop the SRL skills in the self-reflection phase. Only two primary school participants use revision and oral testing to teach their children to self-evaluate their comprehension and preparedness for tests. They furthermore rely on teacher feedback to judge their homework performance.

## Finding 3: Contextual factors that obstruct or promote parental involvement to develop self-regulated learning skills in learners

Results further revealed that parental involvement in lower quintile primary and secondary schools is hampered and supported by various contextual factors.

The prevalent factors in this investigation that challenge parental involvement in homework and obstruct the development of SRL skills are consistent with findings from previous studies on factors that influence parental involvement in school work (Parmaswar 2014; Pomerantz et al. 2007; Vasquez et.al. 2016). The factors from findings in this investigation are as follows: time constraints to be involved caused by work and family responsibilities; insufficient knowledge and skill to provide meaningful, cognitive assistance with homework caused by low educational levels or curriculum reform (Miller & Keeler 2017:37); and lack of specialised subject knowledge in subjects such as Technology, Mathematics, Science, Tourism and Business Studies. Another challenge only experienced in the lower quintile secondary schools, in this research, was participants' lack of knowledge to support their children with learning difficulties. Other challenges that surfaced in the lower quintile schools in this research was homework that does not build on adequate class activities (Mays et al. 2012:453), unclear homework instructions and the shortage of textbooks to give parents enough information to assist their children. Factors mentioned are rooted in the SES of parents living in the communities of these lower quintile schools such as: unemployment, lack of finances to provide educational resources, time constraints and disturbances from unsavoury, noisy communities.

Teachers who are prepared to provide additional help with instructions are perceived as supportive factors that ease their parental involvement with homework. Other supportive factors are participants' own commitment and help-seeking skills to ensure their children's education success, open communication with their children, their secondary school knowledge and skills and the assistance from knowledgeable family members.

## Recommendations

Based on the findings of the research, the following recommendations are made to improve parental involvement to develop SRL skills and the persisting poor academic achievement in lower quintile schools.

Schools should ensure that they have homework policies to prepare parents for the roles they have to fulfil. Schools should educate parents about curriculum reforms and the implications it has for parental assistance in homework. Homework policies should outline the types and frequency of homework activities, the resources parents need to provide and the type of assistance that is required from parents. By means of newsletters or teacher–parent meetings and workshops, teachers should enlighten parents about parenting styles and how it affects learner motivation, the development of SRL skills and over all academic achievement.

Contextualised training for lower quintile school teachers should be offered to train them how to guide parents in the roles they could play for the development of SRL skills in their children.

Clear instructions should be given in homework activities. Teachers should consider whether parents are financially able to provide educational resources, have sufficient time, suitable living conditions and educational backgrounds to give the required parental assistance with homework.

Parental guidance for the academic support of learners with barriers to learning, which might be more prevalent in poor communities, is required. The tendency that parents do struggle with learners' homework should be discouraged and the value of developing self-regulated learners should be emphasised.

Parents should be made aware of the negative consequences of a result and achievement orientation towards their children's education. They should be guided how to rather develop proximal academic goals and mastery goal orientations in their children. Parents should receive guidance and practical examples of how they can develop SRL skills in their children through their own self-directedness, modelling, scaffolding and feedback.

Future research needs to explore parental involvement with a bigger sample of participants from both lower and higher quintile schools.

The research was subject to some limitations. The findings on parenting styles and parental involvement to develop SRL cannot be generalised to all lower quintile primary and secondary schools at large.

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## Foreword

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## Preface

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## Chapter 1

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## Chapter 4

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## Chapter 5

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## Chapter 7

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## Chapter 10

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# Index

Setting one's own goals for life, learning trajectories and world-of-work aspirations as well as crafting pathways to achieve our goals, fulfilment… our dreams require positive dispositions and knowledge of the construct 'self-directed learning'. The collection of significant research questions addressed in this book problematise, theorise and generate evidence on useful educational designs that can be explored and implemented in education offerings across all levels to cultivate learners who are self-directed in a world that is overwhelming in its information generation and demands on selves. In times of remote learning, teaching and working in the Fourth Industrial digital age, self-directedness is imperative – not a nice-to-have! Also, in non-digital contexts of learning in developing contexts, which is the reality of many South African learners and students, becoming self-directed, metacognitively aware and reflective are life-long competencies to be developed.

**Prof. Annemarie Hattingh, School of Education, Faculty of Humanities, University of Cape Town, Cape Town, South Africa**

The work provides a well-organized and coherent set of studies, all specifically addressing separate, more in-depth aspects of Self-directed learning (SDL) as it relates to teaching and learning in higher education. Manifest in each chapter is the impact that Self-directed learning can have on educational practice. The contributions in the book provide numerous ideas and offer guidelines on how to implement SDL in course work and also provide in-depth evaluations of both teachers and students on how to actually engage in SDL. Some of the chapters clearly have a more narrative conceptual focus while others are substantiating notions on SDL with empirical material. The overall framework the editors pose on the book has led to a cohesive and readable work that builds on current notions of SDL and furthers it by adding new insights on implementing SDL. As a whole, this book may inform facilitators, as well as scaffold them in engaging with SDL as a tool and approach to their development and that of their students. The book's main premises are delivered; that is: (a) 'contributing to the scholarly discussion on creating dispositions towards SDL among all learners' and (b) 'devoted to demonstrating its impact on educational practice.'

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