

Preparing pre-service teachers to guide and support learning in South African schools


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Background: Given the poor academic performance in many schools and the inequality in learning outcomes, there is an urgent need to improve teaching and learning in South African schools. Recognising the importance of preparing pre-service teachers to guide and support learning in varying schools in South Africa, we piloted a course in 2020 in which we taught final-year pre-service teacher education students a new way of designing lessons. The lesson design approach foregrounded learning.

Aim: The study aimed to address the question 'What are pre-service teachers' views on how the course prepared them for teaching?'

Setting: The study took place in the Department of Childhood Education at a South African university.

Methods: The study followed an interpretive research approach. To generate data for the study, semi-structured interviews were conducted with 15 pre-service teachers at the end of the academic year. In addition, I conducted stimulated recall interviews on lessons that the pre-service teachers designed.

Results: The results indicated that the pre-service teachers viewed learning about the science of learning and competencies for a fast-changing world as valuable to enrich their teaching. Despite being aware that they still had some gaps in their understanding of some teaching strategies, the results showed that pre-service teachers valued the strategies they learned in the course.

Conclusion: Based on the findings, I conclude that the knowledge the pre-service teachers gained from the course has provided them with a sound basis to guide and support learning in varying school contexts.

Keywords: pre-service teachers; lesson design; science of learning; competencies for a fast-changing world; teacher education; South African schools.

Introduction

In South Africa, the schooling system can be described as two-tiered (De Kadt et al. 2014:171). The first tier comprises a small number (25%) of schools that charge high attendance fees and which are considered high performing and well resourced. The second tier consists of the remaining 75% of schools, regarded as low performing and poorly resourced. These schools charge much lower (if any) fees. The so-called no-fee schools are characterised by continuous underperformance and 'children with extremely low skills levels' (De Kadt et al. 2014:172). These schools face many challenges that inhibit effective learning from taking place, such as overcrowded classrooms, inadequate infrastructure, inadequate resources (no libraries, no laboratories, no Internet access), lack of sanitation facilities and lack of water and electricity (Amnesty International 2020; Mouton, Louw & Strydom 2013).

Most children in South Africa attend no-fee schools, which dramatically affects their life chances. According to Spaull (2019:1), the average South African child's life chances are still determined by 'the colour of their skin, the province of their birth, and the wealth of their parents'. Coetzee (2014:4) poignantly explained: 'The school choice of many black parents living in poor neighbourhoods is limited to the low quality schools available to them by virtue of the area in which they live'. Therefore, the children who attend no-fee schools in impoverished communities must receive quality education to improve their chances later in life. Amnesty International (2020:17) stated that education could reduce inequality in South Africa. According to Taylor (2019:279), the South African schooling system (in which initial teacher education plays a vital role) has the task of 'raising quality across the board'.

One way to raise the quality of education in South Africa is by ensuring that newly qualified teachers are 'sufficiently knowledgeable, skilled and prepared' to teach in South African schools (Taylor 2019:247). Because teaching is about guiding and supporting the learning of others, good teaching presupposes a thorough understanding of how learning happens and how to guide and support learning in any school context. According to Darling-Hammond (2006):

[T]eaching is in the service of students [learners], which creates the expectation that teachers will be able to come to understand how students learn and what various students need if they are to learn more effectively – and that they will incorporate this into their teaching'. (p. 303)

This is also the view of Coe et al. (2020:10) who argued that 'teaching must be defined by its impact: a great teacher is one whose students' learn more'. Thus, to raise the quality of education in South Africa, teacher education programmes should develop pre-service teachers' knowledge of the nature and process of learning and how to guide and support learning in diverse educational contexts (Agarwal & Bain 2019; Darling-Hammond & Oakes 2019; Kitchen & Petrarca 2016; Moore et al. 2020). Gravett (2020a:1) argued that pre-service teachers should be prepared to become 'learning specialists'. Darling-Hammond and Oakes (2019) studied seven teacher education programmes that are widely considered effective in preparing pre-service teachers for the profession and concluded that each programme placed a deep understanding of how children learn at the heart of their curriculum.

Recognising the importance of preparing pre-service teachers to guide and support learning in varying schools in South Africa, we (a fellow teacher educator and myself) piloted a course in 2020 in which we taught final-year pre-service teacher education students in the Department of Childhood Education¹ at the university where this study took place a new way of designing lessons. The lesson design approach foregrounds principles derived from the science of learning literature and competencies for a fast-changing world. The research reported on in this paper addresses the question 'What are pre-service teachers' views on how the course prepared them for teaching?'.

Preparing pre-service teachers to guide and support learning in varying school contexts

South Africa is one of the most unequal countries globally and can be characterised by 'widespread poverty, high unemployment and systemic inequality' (Amnesty International 2000:29). In South Africa, 'poverty and privilege' live side by side (Spaull 2019:4), with 20% – 25% of individuals (multiracial) having access to quality education and stable employment. By contrast, 75% of people in South Africa are

subject to sustained unemployment or 'precarious work with few long-term benefits' (Spaull 2019:4). This group of individuals primarily consists of black and coloured South Africans. According to Amnesty International (2020), more than half of black South Africans live below the poverty line, compared with less than 1% of white individuals. Inequality also permeates the South African education sector, which has one of the most unequal schooling systems in the world. Given the widespread inequality in the country, it is unsurprising that the education system is one of the most unequal in the world and continues to be plagued by 'stark inequalities and chronic underperformance' (Amnesty International 2020:6–7).

Most primary schools in South Africa can be characterised by poor academic performance (Department of Basic Education [DBE] 2015; Hoadley 2012; Osman & Booth 2014; Taylor 2008). According to Taylor (2019:321), '[u]nacceptably wide inequalities persist in South Africa's education outcomes'. As explained in the introductory section of this paper, most learners in South Africa attend no-fee schools, which continuously underperform and produce learners with extremely low skills levels, particularly in reading and mathematics. Evidence for this can be seen in the results of the 2016 PIRLS (Progress in International Reading Literacy Study) and the 2019 TIMSS (Trends in International Mathematics and Science Study) (Van der Berg & Gustafsson 2019). In the 2016 PIRLS, South African Grade 4 learners achieved the lowest overall score out of 50 participating education systems (Howie et al. 2017). The 2019 TIMSS results indicated that Grade 5 South African learners were among the three lowest performing countries (out of 64 participating countries) in mathematics and science (DBE 2019).

In many schools, poor academic performance can be attributed to a range of factors. According to the DBE (2015), these factors include inadequate school infrastructure, overcrowded classrooms, inadequate curriculum coverage and delivery and lack of resources and support materials. Learners' poor academic performance can also be attributed to what is (and isn't) happening in classrooms. Hoadley (2012) reviewed classroom-based studies to determine what is happening in terms of teaching and learning in South African primary schools. She found that learning does not take place in many primary schools because learners have limited opportunities to read and write; teachers do not provide adequate feedback on learner responses; tasks/activities have low levels of cognitive demand; teachers do not use textbooks or other written forms of text and concrete meanings dominate over abstract meanings. Hobden and Hobden (2019) studied learners' written work in South African primary schools and found that learners' opportunities to learn (as evidenced in their writing) were ineffective. According to Marais, Nel and Dlavane (2019:1), many learners perform poorly because of 'many teachers' lack of understanding of and inability to adequately convey the content knowledge of the subjects they are teaching'.

1.Pre-service teachers who complete the undergraduate programme in the Department of Childhood education where this research took place qualify for teaching positions in the foundation phase (Grades R–3) or intermediate phase (Grades 4–7) of schooling.

Given the poor academic performance and inequality in learning outcomes, there is an urgent need to improve teaching and learning in South African schools (Metcalfe & Witten 2019; Taylor 2008, 2019). In the Action Plan to 2019, the DBE (2015) highlighted the need to increase the number of learners in Grades 3 and 6 who have mastered the minimum language and numeracy competencies. According to Taylor (2019), inequality in learning outcomes could be reduced if the quality of teaching and learning is improved in the less well-functioning parts of the school system. He further argued that primary school learning inequalities should be addressed because early grade literacy and numeracy proficiency predict later educational outcomes.

One way the quality of education (and learning outcomes) can be raised is by ensuring that newly qualified teachers who teach in the primary school can guide and support learning in varying schools in South Africa. It goes without saying that '[i]mproving what teachers do in their classrooms is the key to improved learning' (Taylor 2008:21). This was also the view of Marais et al. (2019), who argued that teacher competence is one of the most critical factors affecting educational quality. Osman and Booth (2014:162) argued that pre-service teachers should be prepared 'in a way that will enable them to respond to the learning needs of learners and to decide which pedagogies are best suited for this purpose' and that teacher education programmes should 'produce teachers who can teach in all schools in the country, not just elite schools reserved for the privileged few'.

One way teacher education programmes can prepare pre-service teachers to guide and support learning in any school context is by immersing them in the design of lessons that require them to make their knowledge of the nature and process of learning explicit. In lesson design, pre-service teachers can make their knowledge of the nature and process of learning explicit through their pedagogical choices and their reasoning for making specific pedagogical choices (in relation to the support learning). According to Marais et al. (2019:2) 'good planning is crucial if student teachers need to have an impact on the learning of learners'. In order to prepare them to guide and support learning in varying schools in South Africa, we piloted a course in which we introduced pre-service teachers to a new lesson design approach, one that foregrounded principles derived from the science of learning literature and the development of competencies for a fast-changing world. The course is briefly explained in the next section.

The course on lesson design

As mentioned in the introduction, we piloted a course with final-year pre-service teachers in the Department of Childhood Education at the university where this research took place. In the course, pre-service teachers were taught a new lesson design approach. The lesson design approach was different from what pre-service teachers did in their previous 3 years of study and foregrounded principles derived from the literature on the science of learning and

competencies for a fast-changing world. Anecdotal evidence gleaned from discussions with colleagues (who teach in the department where the research took place) and pre-service teachers suggested that pre-service teachers used the previous lesson planning approach that was implemented in the department as a 'recipe' to plan lessons, and it did not require thoughtfulness in design. The lesson planning approach also did not require pre-service teachers to make the rationale for their teaching decisions explicit. This often resulted in the planning of incoherent lessons where learning seemingly would not have occurred if the lessons were taught to learners. Gravett (2020b) conceptualised the new lesson design approach, which was workshoped with teacher educators and research collaborators in November 2019. This led to revision and refinement of the approach. During the workshop, the participants worked together to co-design a new lesson design template. Gravett (2020b) captured the new lesson design approach in a guiding document. In 2020, I worked with a colleague to design and teach the pilot course in which pre-service teachers were guided to use the new lesson design approach. The lesson design approach foregrounds principles derived from the science of learning literature. Agarwal and Bain (2019) argued that one way in which teacher education programmes can develop pre-service teachers' knowledge of the nature and process of learning (and how to guide and support learning), is by incorporating the science of learning into their programmes. This is also the view of Moore et al. (2020:4) who argue that teacher education courses should develop pre-service teachers' knowledge of the science of learning so that they (pre-service teachers) can use this knowledge 'flexibly' to attend to 'what matters most for the learning and development of their students [learners] while they adapt to the changing contexts in their schools and classrooms'. The science of learning, which is often referred to in the literature as the 'learning sciences', refers to research aimed at understanding the science behind learning (Fischer et al. 2018; Hoadley 2018). The science of learning can be seen as an 'amalgamation of research in psychology, education, neuroscience, machine learning, linguistics and others' (Zosh et al. 2018). Dumont, Istance and Benavides (2010) suggested that the science of learning could provide a lens for creating environments where learning can flourish, where learners can acquire high levels of knowledge and skills. Gravett (2020b:3–8) articulated eight principles derived from her reading of the science of learning literature applicable to lesson design. In their lesson designs, pre-service teachers were required to explicitly state which science of learning principles had been invoked (and how). They were also required to explain the rationale for their teaching decisions. The purpose of requiring pre-service teachers to invoke the principles in their designed lessons was to increase their understanding of how learning happens and explore ways to guide and support learning.

The principles are briefly summarised here:

- We understand/learn new things/ideas by relating them to what we already know. For learners to remember what

they learn, they must relate it to their prior knowledge (existing knowledge) in a meaningful way. For meaningful learning to occur, learners thus need relevant prior knowledge. This implies that teachers must establish what learners already know about the new content they will teach (Kirschner & Hendrick 2020).

- Our working memory is limited. Too much information swamps our working memory. Being presented with too much information at once swamps/overwhelms the working memory (Deans for Impact 2015; Rosenshine 2012). To optimise learning, teachers need to reduce unnecessary distractions during lessons, help learners pay attention to the main aspects they want them to learn, and ensure that they do not overload learners' working memories (Darling-Hammond et al. 2019).
- Proficiency/skill requires engagement and practice. For a learner to become proficient/fluent at a task/skill, they need many opportunities for practice (Brown, Roediger & McDaniel 2014; Deans for Impact 2016; Willingham 2009).
- Transfer of learning does not happen automatically. Transfer is defined as the 'ability to extend what has been learned in one context to new contexts' (National Research Council 2000:51). Transfer of learning is essential. However, research shows that transfer does not happen automatically. Continued practice is a significant contributor to the transfer of knowledge (Bransford & Schwartz 2001; Willingham 2009).
- Learning requires cognitive engagement, which is supported through a moderate challenge that elicits interest. For meaningful learning to occur, learners need to be cognitively engaged with the learning content (National Academies of Sciences, Engineering, & Medicine 2018). Cognitive engagement entails paying attention to something and thinking (deeply) about it (Kirschner & Hendrick 2020).
- Emotion and cognition are intertwined. Meaningful learning is more likely to occur when learners feel physically and psychologically safe in the classroom. Darling-Hammond et al. (2019:13–14) argued that children 'learn more effectively when they are not anxious, fearful, or distracted by other pressing concerns'. Teachers, therefore, need to create safe (physically, emotionally and psychologically) supportive learning environments (Darling-Hammond et al. 2019; National Scientific Council on the Developing Child 2018).
- Learners learn more effectively if they understand how they learn and manage their own learning. Metacognition highlights the importance of helping learners take control of their learning. Learners need to be able to identify when they understand something and when more information is required. Metacognition assists learners with monitoring, evaluating and optimising their learning (Darling-Hammond et al. 2019).
- Innate ability does matter but effort can yield gains. Learners differ in intelligence. However, intelligence can be improved through sustained hard work (Deans for Impact 2015; Willingham 2009). This principle points to the notion of having a growth mindset. According to

Dweck (2015), a growth mindset is a belief that success is dependent on time and effort.

In addition to invoking principles derived from the science of learning literature in their design of lessons, the lesson design approach required pre-service teachers to infuse the development of competencies for a fast-changing world deliberately and demonstrably in their lessons. Pre-service teachers had to decide which competencies they wanted to develop during lessons, and they had to consider which teaching actions may develop these competencies (and vice versa). In other words, pre-service teachers had to embed the development of competencies in teaching knowledge. Integrating the development of knowledge and competencies will assist learners in developing the competencies that will prepare them for a fast-changing world. According to Gravett (2019:2), these competencies are required to 'live and thrive (if not survive) in a rapidly changing world'. Drawing mainly on the work of the Center for Curriculum Redesign (www.curriculumredesign.org), the competencies that were foregrounded in the lesson design approach were the 4Cs – namely collaboration, communication, creative thinking and critical thinking. We also focused on metacognition. Gravett (2019:3) argued that 'cultivating the four Cs', which are widely considered essential 21st-century skills, is crucial in preparing learners to deal with the complexity and ambiguity of the future.

Coursework included academic readings, video clips, case studies and so forth and was drawn from the literature on the science of learning, competencies for a fast-changing world and expert teacher techniques (such as the techniques in Teach Like a Champion (Lemov 2010). The course also included a practice component where pre-service teachers would form small groups (of approximately six pre-service teachers) and have the opportunity to practise teaching strategies that reflected the science of learning principles and competencies for a fast-changing world (e.g. think, pair, share; group work; cold calling; turn and talk; the use of open-ended questioning; retrieval practice, etc.).

After engaging with the course content, the pre-service teachers were required to design lessons in a cyclic (iterative) fashion. This is similar to the microteaching lesson study (MLS) approach, which foregrounds the cyclic, collaborative development of lessons (Fernandez 2010). During the first cycle, pre-service teachers designed the 'introduction' phase of the lesson. In the second cycle, they designed the 'body' of the lesson (engaging with the new content phase). They also had to include a revised version of the introduction phase based on their feedback from the same teacher educator who facilitated their small-group practice and reflection sessions (discussed in the next paragraph). During the third cycle, pre-service teachers submitted a revised version of the lesson's introduction and 'body' (again based on feedback received from the small-group practice and reflection session facilitator) and designed the 'consolidation' phase of the lesson. In the fourth (final) cycle, pre-service teachers revised all three phases to align elements and submitted a

final version of their lesson design. Throughout the year, pre-service teachers submitted their lesson designs on the learning management system of the university. This made it possible for the small-group practice and reflection session facilitators to grade their lesson designs and write extensive usable feedback.

During each cycle of design and refinement (iterative lesson design), pre-service teachers received feedback on their lessons from the same teacher educator who facilitated their small-group practice and reflection sessions. The teacher educators who facilitated the small-group practice and reflection sessions are similar to what Fernandez (2010:352) calls 'knowledgeable advisor[s]'. During the small-group practice and reflection sessions (which consisted of approximately 12–15 pre-service teachers), the teacher educators expanded on concepts covered in the course content. Pre-service teachers were able to discuss their lesson designs with their peers (and the teacher educator) and share ideas. The teacher educators who facilitated the sessions also offered guidance on areas where pre-service teachers could improve their lesson designs. In addition to providing pre-service teachers with the opportunity to reflect on and share their design decisions, the sessions also included a practice component of specific strategies covered in the course (e.g. using open-ended questioning to elicit learners' prior knowledge on a topic).

Research methods

The research reported on in this paper addresses the question 'What are pre-service teachers' views on how the course prepared them for teaching?'. To this end, an interpretive research approach was followed in accordance with the views put forward by Schwartz-Shea and Yanow (2012). In interpretive research, knowledge is assumed to be socially constructed and that participants can have different interpretations of a phenomenon or event. Interpretive research thus focuses on meaning-making, specifically, understanding how individuals in specific settings make sense of their worlds (Schwartz-Shea & Yanow 2012). Because the research reported in this paper aims to explore pre-service teachers' views about how the course prepared them for teaching, an interpretive research approach was best suited.

Interpretive research aims to understand how individuals make sense of an event or phenomenon in specific contexts (settings). According to Schwartz-Shea and Yanow (2012:57), interpretive researchers should focus on identifying participants that will 'enhance the likelihood of being able to explore the [research] questions that interest them'. Because the paper aims to explore pre-service teachers' views on how the course prepared them for practice, the study participants consisted of the 183 pre-service teachers enrolled for the course. To determine the pre-service teachers' views, I wanted to interview them. Interviewing 183 pre-service teachers was not feasible. Thus, 15 pre-service teachers were randomly chosen to form part of the study. These pre-service teachers consisted of both foundation and intermediate phase students. To generate data (research evidence), semi-structured interviews were conducted with the pre-service teachers at the end of the academic year to determine their views of how the course prepared them for teaching. In addition, stimulated recall interviews were conducted on lessons that the pre-service teachers designed.

Data were analysed using the constant comparative method of data analysis following the views put forward by Maykut and Morehouse (1994) and Merriam and Tisdell (2016). Before starting the process, the data were prepped for analysis and interviews were transcribed verbatim. The constant comparative method of data analysis begins with a thorough reading of each transcript to identify provisional categories. After identifying provisional categories, each transcript was reread to identify individual 'units of meaning' (Maykut & Morehouse 1994:128). Units of meaning were highlighted and assigned a code that contained the essence of the unit of meaning (see Figure 1). After coding the transcripts, similar units of meaning (codes) were sorted into the same provisionally identified categories (see Figure 2), using the 'look/feel-alike' criteria described by Maykut and Morehouse (1994:137). New categories were developed where codes did not 'fit' into the provisionally identified categories. This means that some initial categories were merged, and some were discarded. The process of refining the categories continued by writing rules of inclusion. A rule of inclusion serves as the 'basis for including (or excluding) subsequent data cards in the category' (Maykut & Morehouse 1994:139). An example of a rule of inclusion is 'There is evidence

Interviewer: What have you learnt about teaching this year, that you haven't learnt before, if anything, and how will this influence your practice as a teacher?	Code
Student: Ok. What I could say I've learnt is, to be honest was the use of the principles, well the new lesson plan. I've discovered so many ways of teaching that I haven't learnt before. For instance, I knew that you do have to acquire learner's prior knowledge, but I didn't know skills or strategies in order to find out learners prior knowledge. For me it was just maybe asking one or two questions and then moving forward. Whereas there are strategies that you can use, or do it more consciously to acquire learners prior knowledge and the reasons behind it. So I would say, the principles that we had this year, made it more explicit or conscious of the things that we have to do when teaching, and not just focus on getting the learners to do an activity and see how many of them get it right.	Learnt teaching strategies Learnt strategies to elicit prior knowledge Principles required thoughtfulness
Interviewer: Ok perfect. How do you think knowledge of these principles would influence your practice as a teacher?	Code
Student: I think it would influence my practice as a teacher in terms of planning. I think planning before, it was more of just having a lesson on paper. But I think now I can plan ahead for things that might happen in a classroom. And also be aware of ... what could I call it ... Ok I don't know what's the word for it right now. But I think the principles could assist me in terms of planning a lesson ahead.	Principles will inform lesson planning

FIGURE 1: Example of how transcripts were coded.

Provisionally identified category	Codes
The pre-service teachers are aware that they still have gaps in their understanding of some teaching strategies	<ul style="list-style-type: none"> • Struggles to infuse metacognition • Struggles with assessing for learning • Struggles with designing a lesson series • Struggled invoking principles at first • Initially struggled to apply principles to lesson design • Conflates 4Cs • Struggles to think of creative ways to introduce content

FIGURE 2: Example of how codes were sorted into provisionally identified categories.

that the pre-service teachers are aware that they have gaps in their knowledge/understanding about aspects of lesson design'. Using the constant comparative method enabled me to identify themes in participants' responses and derive their views on how the course prepared them for teaching.

Ethical considerations

The following measures were taken to ensure ethical research: (1) application for ethics approval from the faculty where the study took place; (2) informed consent was requested from the participants who took part in the research; (3) the ethics procedure was explained to the participants before the collection of data and (4) data was treated with a strong measure of confidentiality.

In this study, I took on the role of researcher and situational participant, as explained by Gans (1976 in Schwartz-Shea & Yanow 2012:63–64). I was participating in my situation-specific role as teacher educator, but at the same time I was always observing as a researcher. This dual role was because of my involvement in the design and piloting of the course and simultaneous researching what pre-service teachers learned from the implementation of the course. Because of my involvement as a teacher educator in the course that was being researched, I was cognisant of potential power relationships between myself and the pre-service teachers who were part of the research, and how these could influence the research process. Participants were informed that they were not obliged to participate in the research and that they could withdraw from the research any time if they wished and that their withdrawal would not result in any negative repercussions.

Findings

The data analysis process generated four categories that encapsulated the pre-service teachers' views on how the course prepared them for teaching. The categories are presented in the sections that follow.

The pre-service teachers view learning about the science of learning as valuable to enrich their teaching

The analysis of the stimulated recall interviews and the semi-structured interviews showed that the pre-service teachers

viewed learning about the science of learning as valuable to enrich their teaching. The data indicated that the pre-service teachers view learning about the science of learning as valuable because it has enriched their understanding of how learning happens. The following excerpts from interviews encapsulate this finding:

'The science of learning is basically what I have taken from this, that we need to invest more time in knowing how our learners learn and applying that to our own practice. Because if we don't know how our learners learn, and how they take in information, then we will be planning lessons that are useless, and obviously that will show in our assessments when we assess our learners and so on. So it's very important for us to make sure that our learners grasp the content of the lessons that we are teaching them.' (IP pre-service teacher 1, Semi-structured interview, October 2020)

'Now I understand how learners learn. I understand what I feel needs to go into a specific lesson plan, and which principles to touch on in order to, basically reach the objectives and aims that are mentioned in the lesson.' (FP pre-service teacher 4, Semi-structured interview, October 2020)

The data revealed that one reason the pre-service teachers learned about the science of learning (and how this will enrich their teaching) is that invoking the science of learning principles in lessons required them to be thoughtful. Pre-service teachers explained that thinking carefully about how and why to invoke the science of learning principles in the lessons they designed contributed to their understanding of how to design lessons that foreground learning. The following excerpts are indicative of this finding:

'It allows you to think about how you want to teach the content, and how you want your learners to learn.' (IP pre-service teacher 2, Semi-structured interview, October 2020)

'We have to think about how we can best apply these principles for learning to take place.' (FP pre-service teacher 1, Semi-structured interview, October 2020)

'Thinking of the learning principles actually helps you to think of activities to use in the lessons.' (FP pre-service teacher 7, Semi-structured interview, October 2020)

The pre-service teachers valued the strategies that they learned in the course

There is evidence that the pre-service teachers learned strategies in the course to support learning. Additionally, there is evidence that they value the strategies they have learned. Table 1 highlights the strategies learned (and valued) by pre-service teachers. Included in the table are examples from the raw data.

The pre-service teachers are aware that they still have gaps in their understanding of some teaching strategies

There is evidence that the pre-service teachers are aware that they still have gaps in their understanding of some strategies (that support learning). In particular, from their perspective, pre-service teachers seem to struggle with formulating open-ended questions. Evidence for this can be seen in the following excerpts:

TABLE 1: Strategies learned (and valued) by the pre-service teachers that could support learning.

Strategies to support learning	Examples from the raw data
Peer learning	<p>'I always had them do discussions with their peers, the people sitting next to them, their shoulder partners. So I'd ask a question and then I would say 'you have one minute to discuss this question with your shoulder partner' and I'd then ask some of the pairs what their answers were.' (FP pre-service teacher 7, Stimulated recall interview, September 2020)</p> <p>'I had a small activity where I wanted my learners to work in groups. That was more for how I wanted them to learn how to collaborate.' (FP pre-service teacher 3, Stimulated recall interview, September 2020)</p>
Eliciting prior knowledge	<p>'I've discovered so many ways of teaching that I haven't learnt before. For instance, I knew that you do have to elicit learners' prior knowledge, but I didn't know skills or strategies in order to find out learners' prior knowledge. For me, it was just maybe asking one or two questions and then moving forward. Whereas there are strategies that you can use, or do it more consciously to elicit learners' prior knowledge and the reasons behind it.' (FP pre-service teacher 3, Semi-structured interview, October 2020)</p>
Questioning	<p>'I have learnt how to use cold calling.' (FP pre-service teacher 2, Stimulated recall interview, September 2020)</p> <p>'I had to make sure that the questions would, were designed in a way, where, you know, it will give me an idea where my learners are, when it comes to their learning experience.' (FP pre-service teacher 1, Stimulated recall interview, September 2020)</p> <p>'If you can go through my lesson plan you will see, that with every activity afterwards there are questions that I am asking. OK why did you do this, why did your friend do that, why did you put this under that, so that they can be able to share and vocalize what they were thinking in their head.' (FP pre-service teacher 5, Stimulated recall interview, September 2020)</p>
Assessment	<p>'As a teacher you need to always make sure that you are assessing the students' learning, seeing where they are.' (IP pre-service teacher 1, Semi-structured interview, October 2020)</p> <p>'This year I kind of started noticing more about, where learners actually make little errors, and when it's an actual misconception and how to address the differences between those two. Like how to know if they just made a calculation error or if it is an actual misconception of the concept.' (FP pre-service teacher 7, Semi-structured interview, October 2020)</p>
Using playful learning activities	<p>'I've learnt that teaching doesn't always have to be serious. You can also include games and all the fun activities and still assess and also teaching will still take place. And I think that is one thing that is valuable for me.' (FP pre-service teacher 6, Semi-structured interview, October 2020)</p> <p>'Basically all children love playing, so playing a game is much more interesting than just answering questions and that.' (FP pre-service teacher 7, Stimulated recall interview, September 2020)</p>
Engaging learners in practice	<p>'I've learnt that I shouldn't expect learners to respond to my teaching now, but it takes practice. So meaning that in my teaching, give it time, and also give more practice for learners to catch on what I'm teaching.' (IP pre-service teacher 7, Semi-structured interview, October 2020)</p> <p>'I knew that with whatever I was teaching, I have to make sure that there was an activity that will engage them in practice.' (FP pre-service teacher 2, Stimulated recall interview, September 2020)</p>

'It is something most teachers struggle with, is open-ended questions. Because we can ask 'Do you understand?' and the learners can say yes, but we don't know if they understand. So that's why I think questioning is a really difficult thing to implement.' (FP pre-service teacher 1, Stimulated recall interview, September 2020)

'Sometimes when you are dealing with grade 2 learners, it is a bit hard to try and formulate open ended questions. So I had a bit of difficulty when formulating questions.' (FP pre-service teacher 4, Stimulated recall interview, September 2020)

When discussing learner engagement, pre-service teachers sometimes conflate engagement with participation. Some pre-service teachers believe that when learners are physically doing something during a lesson, they are cognitively engaged. One pre-service teacher said during the stimulated recall interview (when asked how she designed for learner engagement):

'As soon as you get learners to move around and stuff, they feel less intense, they feel comfortable. So it makes it easier for them to respond. And then you make it seem like game. So, as soon as they, you know, start moving around and stuff they actually get excited to be part of the lesson.' (FP pre-service teacher 2, Stimulated recall interview, September 2020)

Some pre-service teachers also struggle with assessment, particularly, using assessment to determine whether learners have learnt during a lesson. One pre-service teacher commented during the semi-structured interview:

'I haven't quite grasped how I can actually make sure that, like in a class, practically in South Africa, we have always more than, an average of more than 40 learners in Township classrooms and so on, like how can I have now make learning applicable to that kind of class where I can actually see, in a class of 50 or like 60 if learners have truly engaged in the learning process, if they have actually learnt and stuff like that.' (IP pre-service teacher 1, Semi-structured interview, October 2020)

The pre-service teachers view learning about competencies for a fast-changing world as valuable to enrich their teaching

The lessons that the pre-service teachers designed required them to infuse competencies for a fast-changing world and explain how the competencies had been infused deliberately and demonstrably. This required them to think carefully about how the teaching of competencies could be embedded in content teaching. The analysis of the data pointed to the fact that the pre-service teachers valued learning about the competencies because it will enrich their teaching. The following excerpts from the interviews are proof of this finding:

'I've learnt that it is important to include these competencies in every lesson that we plan. Especially because we are approaching the fourth Industrial Revolution. So it's really important to include these competencies, and I feel like they are not only competencies but they also promote learning.' (IP pre-service teacher 7, Semi-structured interview, October 2020)

'When we think about the world that we live in, and how it is constantly changing, it is important for learners to develop and to learn about these competencies. Because they need them, and sometimes you would think about how you would teach these competencies, and you wouldn't know where to start when you are planning your lesson. But then I have learnt that these competencies, they promote successful learning in the classroom because when you include activities in your lesson plan, they lead to the development of these competencies.' (IP pre-service teacher 2, Semi-structured interview, October 2020)

'What I've learnt about competencies, it's mainly about the skills that learners and ourselves as teachers will have, that will assist us to thrive in this fast-changing world. So for me when it came to teaching, it made me realise that it is not just about delivering content based on the curriculum. It's not only about delivering content based on what is required by the government, or the school. But it's finding out, okay how do we take this curriculum,

and how do I make sure that the activities that I prescribe to my learners actually teach them those 21st century skills, you know? How do I teach my learners to be critical thinkers? How do I teach them to communicate? All of those things.' (FP pre-service teacher 2, Semi-structured interview, October 2020)

Discussion and conclusion

The findings indicate that the pre-service teachers viewed learning about the science of learning as valuable to enrich their teaching. From their perspective, their experiences of designing lessons that required them to invoke principles derived from the science of learning literature developed their understanding of the importance of placing learning central in lesson design. The purpose of requiring pre-service teachers to invoke the principles derived from the science of learning literature in their design of lessons was to increase their understanding of how learning happens and how to guide and support learning in varying schools in South Africa. Moore et al. (2020) argued that teacher education programmes should develop pre-service teachers' knowledge of the nature and process of learning to use this knowledge when they enter the profession to guide and support the learning of the children they teach (in any varying school contexts). According to Willingham (2018:45), 'knowledge of the basic science of learning can improve teaching, and ultimately, student outcomes.'

Preparing pre-service teachers to design and teach lessons that place learning at the centre will serve them and their learners well, no matter the circumstances of the schools where they teach or how the context may change. The findings indicate that the pre-service teachers view learning about the science of learning as valuable because it has enriched their understanding of how learning happens. This will likely influence how the pre-service teachers teach when they enter the profession. When pre-service teachers enter the profession, it is unlikely that they will design detailed lessons in the same way that they were expected to do in the course. However, understanding how learning happens and the importance of placing learning central during lessons (informed by an understanding of the science of learning principles) will serve them well because they will likely foreground learning (no matter the school context) when designing lessons. This is important because, as explained in the introductory section of this paper, the South African education system can be characterised by widespread inequality (Amnesty International 2020). Therefore, children who attend low-performing schools in impoverished communities must receive quality education to improve their chances later in life. The quality of their education can be characterised by how well learners have learnt. Preparing pre-service teachers to teach in an informed way based on an understanding of how learning happens likely equipped them to guide and support learning in varying schools in South Africa.

The findings indicated that the pre-service teachers are aware that they still have gaps in their understanding of some

strategies. A possible reason for the gaps in pre-service teachers' understanding could be attributed to the fact that the course was restructured because of emergency remote (online) teaching. The course was designed, and its implementation was planned before the coronavirus disease 2019 (COVID-19) pandemic. When the COVID-19 lockdown occurred in South Africa (in March 2020), all teaching had to be moved abruptly online. This situation prevailed for the full year of implementing the course (excluding 2 months before the national lockdown). Because of reduced time for teaching and learning (because of extended university recess), we had to decide which aspects of the lesson design approach to foreground and which aspects to spend less time exploring. As a result, some aspects of the lesson design approach were not taught coherently. We will make a change as we advance to ensure that aspects of the lesson design approach are taught in an integrated and coherent manner to strengthen the course. For instance, pre-service teachers should understand that the competencies are not 'add-ons' in lessons. Instead, the development of the competencies should be infused in their teaching of the content, and while they are doing this, the science of learning principles could be invoked in how they plan for the lesson to unfold. For instance, they can elicit learners' prior knowledge during the introduction of a lesson by asking carefully thought-out open-ended questions that require learners to communicate their understanding of the content to their peers.

Despite being aware of some gaps in their understanding, the pre-service teachers valued the strategies that they learned in the course. This will serve them well when they start teaching because they will likely apply the strategies they value (no matter the school context) to guide and support learning. For instance, the pre-service teachers valued learning how to use questioning to guide and support learning. This is a promising finding because the implications of the science of learning principles point to approaching teaching as a learning-focused dialogue (Gravett 2021), and using open-ended questioning purposefully is the 'backbone of teaching dialogically' (Gravett 2021:15). Questioning is something that the pre-service teachers could apply in any varying school contexts. The pre-service teachers also valued learning how to elicit prior knowledge. In an upcoming book chapter, Gravett, Lang and Van der Merwe (2022) explain that the notion that learners' prior knowledge should be activated is widely touted in education. However, many teachers (and pre-service teachers) do not understand the significance of prior knowledge in learning. Subsequently, many teachers (and pre-service teachers) often do not elicit learners' prior knowledge about the new content they teach. Therefore, this finding is significant because the pre-service teachers know the importance of activating and eliciting learners' prior knowledge (no matter the school context). The findings also revealed that the pre-service teachers valued learning about the importance of providing learners with practice opportunities during lessons. This finding is important because the notion that learners need many

practice opportunities to become proficient at a task/skill is widely recognised in the literature on learning (Agarwal & Bain 2019; Brown et al. 2014; Deans for Impact 2016; Willingham 2018).

The findings indicated that the pre-service teachers view learning about competencies for a fast-changing world as valuable to enrich their teaching. This is promising, considering the importance of teachers intentionally developing the competencies that learners will require to live and thrive in a fast-changing world (Gravett 2019; Gravett & Eadie 2020; Magwentshu et al. 2019). The importance of the 4Cs and metacognition (so-called 21st-century skills) are captured in many 21st-century skills/competencies frameworks (Center for Curriculum Redesign 2015; Dobryakova et al. 2018; Marope, Griffin & Gallagher 2017; OECD 2019; Voogt & Roblin 2012; World Economic Forum 2020). Infusing competencies for a fast-changing world in the teaching of content can aid deeper learning. Pellegrino (2017) argued that the development of 21st-century competencies supports deeper learning, and deeper learning is essential for the development of competencies. In other words, the two support each other in a mutually reinforcing style (National Research Council 2012). Thus, it is important for pre-service teachers to learn the value of infusing the development of competencies for a fast-changing world in their teaching of content intentionally.

Based on the findings, I conclude that the knowledge the pre-service teachers gained from the course has provided them with a sound basis to guide and support learning in varying school contexts. Thus, their learnings from the course could serve them as novice teachers and their learners well when they enter teaching and in the long run.

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Author's contributions

D.v.d.M. is the sole author of this article.

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Data availability

Data is available and a link can be provided to a Google Drive folder containing the data if necessary.

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