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Chapter

Using the Research Tutorial as a Training Strategy for Tutor Professional Development in an Undergraduate Course

Duncan Mhakure

Abstract

This chapter is part of a larger research project that seeks to investigate sustainable ways of improving group-based tutoring in higher education courses. A growing body of research into teaching and learning in higher education acknowledges that higher education institutions are regarded as bastions of active teaching and learning that encourage students' deep learning and critical engagement. However, existing research also suggests that there is a lack of active participation by students during learning activities in tutorials; one of the reasons is the poor quality of the interactions between tutors and students during tutorials. Postgraduate students, who make up the majority of tutors, receive little formal training and lack sophisticated instructional skills on how to facilitate tutorials. By using an example, this chapter argues for the use of a research tutorial as a training strategy for tutor professional development (TPD) in an undergraduate Quantitative Literacy (QL) intervention course. The research methodology employed in this study is the lesson study. A research tutorial is a tutorial designed by both tutors and researchers that is used for TPD purposes. Suggestions for future research include focussing on how tutors notice, and attend to, the students' productive struggles during an undergraduate QL tutorial.

Keywords: peer tutoring, research tutorial, deep learning, cooperative learning, lesson study, students' productive struggles

1. Introduction

Tutoring in small groups to facilitate cooperative learning is not a new approach in higher education. While tutoring plays an important role in student learning, thus improving throughput and helping students to achieve their professional goals [1–3], the majority of the tutors who engage in tutoring do not receive any formal training [4–6]. This chapter, which is research-based, proposes the use of the research tutorial as a training strategy for TPD in higher education courses. The process of tutoring embodies broad features and characteristics, for instance: academic and educational dimensions; administrative issues—tracking students' performance; classroom practices—teaching of the discipline content; peer tutoring—as observed in many universities, among others. This chapter's focus is on the discourses of student-tutor classroom practices—in other words, what

are the interaction dynamics and mathematical discourses that can be observed in student-tutor interactions during tutoring. A South African higher education context is used as an example of this model of TPD. While this chapter is based in the South African higher education teaching and learning context, international readership, particularly individuals who deal with teaching and tutoring in higher education and/or other learning institutions, including schools, will also find the contents interesting. In other words, the target readership includes both South African and international teachers and lecturers. This chapter is composed of nine sections: *first*, a summary of the chapter—the abstract; *second*, an introduction to the chapter; *third*, the context of teaching and learning in higher education; *fourth*, the interdependence of cooperative learning and tutoring; *fifth*, the research tutorial framework; *sixth*, the operationalisation of a research tutorial; *seventh*, the conclusion; *eighth,* acknowledgements; *ninth,* conflict of interest*; tenth,* appendix: research tutorial—percentage change*;* and *last,* the references.

2. The context of teaching and learning in higher education

A growing body of research into teaching and learning in higher education acknowledges that higher education institutions are regarded as bastions of active teaching and learning that 'promote students' deep learning and critical engagement' ([2]; p. 64). However, existing research also suggests that there is a lack of active participation by students during learning activities in tutorials; one of the reasons for this is the poor quality of the interactions between tutors and students during tutorials [7, 8]. In the context of this chapter, and from a historical perspective, tutoring as a tradition has been in existence since the twelfth century, when the British schools used tutors in special pedagogical positions to assist in the academic development of individual students in schools and higher education institutions [9, 10]. In addition, tutoring was historically used in early European colleges and among the Bourgeois classes and royalty as a form of instruction within these institutions and/or classes [11, 12]. The Latin word *tutor* means 'defender, guardian', and is in turn derived from the Latin verb *tueri*, which means 'to look after, to observe, to guard' ([10], p. 184).

It is true that higher education globally is facing an increasing number of challenges due to the student body becoming more diverse in terms of age, 'ethno-cultural, socio-economic and even linguistic backgrounds' ([13], p. 118), motivation, learning needs, and students' preparedness, among others [14, 15]. In addition, higher education institutions are also faced with perennial under-funding, which is exacerbated by rapid technological advancement [14]. The South African higher education context is no different from that of other countries, particularly third world countries: institutions of higher learning are mandated to address other social challenges, such as the growing demands of accessibility and equity [16, 17], including issues of student retention and throughput, particularly among undergraduate students. Throughout the world, despite universities' efforts to retain students, only half of all students complete their studies in the regulation time [18, 19]. Comparing retention rates between countries is not an easy endeavour, because individual countries measure completion rates differently. For instance, according to [20, 21], the completion rates of the following countries were: Australia (23%), Denmark (24%), Japan (26%), and Ireland (21%); although these figures appear low, they were in fact some of the countries that experienced higher rates In the context of South African higher education, the completion rate in 2011 was 27%—meaning that only 27 out of every 100 students, on average, completed their studies within the regulation time. In other words, 27% of the students did not take an extra semester or year to complete their degree programme. In the United States

of America, studies show that more than 40% of the students who enrolled in 2007 failed to complete their degrees by 2013 [22]. There are many factors that contribute to the low rates of study completion and student retention in universities; these include, but are not limited to: predominant lecturing style of teaching in a large classroom with many students—this style does not encourage students' participation during learning; no monitoring of students' attendance as a pre-requisite for writing or passing the final examinations; and the fact that academic staff are inundated with duties other than teaching, such as grade revision and their own research studies [14]. In recent years, the use of podcasts to record lectures, though positive in many other ways, has contributed to students' lack of active participation in teaching and learning activities. Studies have also shown that contextual factors that hinder students' participation have to do with how institutions allocate resources to student development and learning opportunities that encourage student participation [23–25]. All the factors contributing to low completion and retention rates, in addition to causing high levels of frustration among students and academic staff, furthermore place a huge social and financial burden on the country's fiscus, particularly in countries with free education—such as Norway, and have a significant and negative effect on the quality of teaching and learning [26–28].

The teaching and learning space in higher education is complex and challenging. As already alluded to in this chapter, the greater diversity among higher education students from different linguistic and cultural backgrounds and the creation of learning environments where high levels of student engagement are prioritised, is adding to these difficulties [2, 24, 29]. Research suggests that the introduction of cooperative learning (CL) [30–32], through the tutoring of small groups, for instance, could assist in creating conducive learning environments, which would be better able to address students' lack of active participation and engagement [33, 34].

3. The interdependence of cooperative learning and tutoring

Understanding the interdependence between CL and tutoring is important in the context of this chapter. CL is defined as 'the instructional use of small groups so that students work together to maximise their own and each other's learning' ([35], p. 3). CL represents a shift from lecturing passive big groups of students to tutoring smaller groups, where a tutor is in charge of a small group. In CL, the instruction focusses, through the guidance of a tutor, on stimulating and encouraging student-student and student-tutor interactions during tutoring [35, 36]. These interactions promote a deeper conceptual understanding among students, and foster the development of higher order, social, and critical skills, which are valuable for the students' future life [37].

Student-tutor and student-student interactions discussed in this chapter take place during peer tutoring in the higher education context. In a general sense, peer tutoring entails individuals of the same group or social standing teaching each other, when one of the group members has more expertise or is more knowledgeable than the others [4, 38]. While in higher education peer tutoring is regarded as an integral part of academic development and support programs designed to assist at-risk students, defining the construct of peer tutoring is perceived to be complex, and at times contested [9, 12]. Variations of peer tutoring include: one-to-one tutoring, tutoring small groups—where a tutor oversees a small group of students, and online tutoring—which is used to support students studying through distance education, among others. In this chapter, peer tutoring embodies cross-age tutoring, where postgraduate students in quantitative disciplines assume the role of tutors to undergraduate students in a QL course, and where each tutor deals with

a small group of students [4, 39]. Hence, this chapter uses the word 'tutoring' to refer to peer tutoring of undergraduate students in small groups, with each group facilitated by a senior student/postgraduate student.

Recent lines of research on higher education teaching and learning have shown that institutionalised tutoring is regarded as one of the strategies of encouraging the active participation of students and fostering more proactive interventions that address students' deficits [9]. In addition, undergraduate students need more direct learning, such as provided during tutoring, to help them with assessing their own knowledge deficits [1]. Ideally, a tutor should address undergraduate knowledge deficits by fostering greater student engagement and participation in tutorials. Morano and Riccomini [40] assert that tutoring is one of the instructional strategies that can be used to address 'high order learning objectives including comprehension, application, and problem solving' (p. 104) that are strongly emphasised across all higher education disciplines. It should not be deduced, however, that this chapter is suggesting that tutoring is the only solution of all learning challenges in higher education. Having said that, my position is that tutoring, as a part of university teaching-learning approach can indeed improve the throughput and retention of students and help them to achieve their professional goals [3]. By means of the example in this chapter, I argue for the use of a research tutorial as an effective training strategy of tutor professional development (TPD) in an undergraduate Quantitative Literacy (QL) intervention course. To express it as a research question: How can a research lesson be used as a training strategy for TPD in an undergraduate course?

Higher education studies in many disciplines concur that tutors as facilitators for student learning should be trained through workshops and/or seminars to be equipped with the necessary didactical skills [41]. By collaborating with the relevant discipline's course convenors and/or coauthoring course materials, as part of tutor training, tutors can further develop familiarity with the instructional strategies that promote student learning [42]. Central to the debates on how tutoring improves students' active participation and engagement in learning activities is the efficacy of the tutor training program. Academic development programmes in which tutor training is a key feature tend to contribute more to students' success than do those without tutor training [9]. In other words, tutor training programmes enhance the facilitating of the tutorials, by providing opportunities for feedback and peer interactions that empower tutors to provide better learning experiences during tutorials [6, 43]. McFarlane [44] concurs and posits that 'tutoring in higher education from a tutor's perspective suggests that tutors lack training in tutoring and may lack clarity as to the purpose of the role' (p. 77). One of the key focuses of tutor training is how to transfer the knowledge, skills and behaviours acquired by tutors to real tutoring settings [45]. It is clear that the quality of tutors is one cause for the variations in student learning during tutorials, and that the quality of tutoring programmes directly influences the quality of tutors [46]. In accordance with [47], the word 'quality' in the context of tutoring programmes refers to 'both changes in the environment in which education [tutoring] takes place and the detachable gains in learners' [students'] knowledge, skills and values' (p. 13). Here the word detachable gains are gains that apply outside the tutorial, such as, self-regulation. Despite increase in tutor training programmes and their benefits in developing students' higher order cognitive skills, as already illustrated in this chapter, many more studies on tutor training are emerging [15, 45, 46].

4. The research tutorial framework

In this section, an alternative tutor training model is presented. The origins of this model are based on the construct of the lesson study framework and the notion of

the research lesson—both of which have been popularised in mathematics education, particularly in schools [48–50]. As a form of continuous professional development (CPD) for mathematics teachers, [50] asserts that a lesson study is an approach:

> *in which teachers [tutors and academics] work together to: formulate goals for student learning and long-term development; collaboratively plan a 'research lesson' [research tutorial] designed to bring to life these goals; conduct the lesson [tutorial] in a classroom, with a team member teaching [tutoring] and others gathering evidence on student learning and development; and discuss the evidence gathered during the lesson [tutorial], using it to improve the lesson [tutorial], the unit, and instruction more generally (p. 95)*

Within the context of this chapter, a lesson study framework as a form of TPD for tutors is a tutor-enquiry based CPD whose specific emphasis is to reflect on tutoring classroom practices and students' cognition, thus developing the tutor's expertise and learning within a higher education context [49, 51]. Tutor-enquiry based training using a lesson study, and more specifically a research tutorial, is a possible solution for the TPD of tutors in higher education. A research tutorial is a tutorial that is jointly planned (prepared), implemented, and evaluated through reflections by both tutors and researchers within a discipline and/or degree programme. This chapter uses the term 'researchers' to refer to: academics, such as lecturers and convenors of higher education courses, as well as other higher education stakeholders in higher education, whose interests lie in tutor development. As such, the research tutorial is examined through three lenses [52]: The first is *the researcher lens,* which encourages tutors to act as researchers in identifying problems of practice (such as students' productive struggles), designing appropriate strategies to solve them, and using the findings to inform and improve the success of their tutoring interventions. While the role of the tutor is to help students to learn, there is general acceptance that undergraduate students, through no fault of their own, find it difficult to assess their own knowledge deficits [1]. It is one of the tutor's roles to design and provide interventions to ameliorate such knowledge deficit challenges among students [53], ideally, by gathering information about the level of understanding among the students in the group [54, 55]. The second, *the curriculum development lens,* looks at how tutors sequence learning tutorial activities and align them to the students' learning and cognition during tutorials. In addition, the act of tutoring involves further challenging the students' cognition, particularly with respect to simplification, clarification, and exemplification of learning tasks [39]. Lastly, *the student lens*, is about how tutors predict possible solutions and challenges to students' learning tasks, and how they use these predictions to inform further student engagement. In addition, this lens refers to how tutors use their knowledge about students, and their knowledge of their peers as resources for planning, facilitating and evaluating students' interactions during tutorials. It is relevant to mention that the tutor's main role is to create an environment that supports student learning; often, however, tutors find themselves dealing with students' other distressing and intensely personal issues, which are not part of their discipline context [44, 56].

Considering what has been said earlier, this chapter discusses tutoring in an undergraduate course—viz. the QL course, so the context presented is very specific to this course. While tutors have many different roles, the focus in this chapter is on classroom practice and discourse, in other words, on facilitating the discipline content. Only postgraduate students from quantitative disciplines are interviewed and, if selected, are eligible to be tutors for this course. Successful candidates are required to attend a compulsory orientation seminar before assuming their tutoring duties, and before being subjected to further training, as defined by the research

tutorial framework. It is during the orientation seminar that tutors, and researchers discuss the learning needs of the students in the course, as well as the curricular goals of the course. In addition, the orientation seminar is used to assess the developmental needs of tutors before they engage in tutoring.

The research tutorial framework that the chapter is proposing consists of four phases. The characteristics of this framework make it an effective tool for TPD, because 'it is site-based, practice-oriented, focussed on student learning, collaboration-based, and research-oriented' ([57], p. 2). In other words, the framework can be adapted to address the needs of the tutors and student learning in a variety of contexts. **Figure 1** shows the four phases of the research tutorial framework, viz. *setting goals, planning, implementing, and debriefing*, and how these are related to each other [58].

Firstly, in the *setting goals phase*, tutors and researchers meet formally to discuss the specific students' needs, and the curriculum goal for the undergraduate QL

Phases of a research tutorial	Tutors' and researchers' co-learning activities from the research tutorial	Outcomes
1. Setting goals	Tutors and researchers discuss the objectives of the research tutorial within the contexts of the students' academic needs, and curricular goals.	**TPD leads to improvements in**: tutor classroom practices; classroom discourses; student-tutor interactions; deeper understanding of the subject content; student learning; tutor critical inquiry and reflection on tutorials; knowledge of a variety of instructional methods; and flexibility to change instructional strategies during tutoring **For students, quality tutoring leads to improvements in**: success rates; retentions of at-risk students; and undergraduates' sense of social and academic integration
↓	**Between Phases 1 & 2**: Tutors and researchers brainstorm and research the mathematics concepts and think about concepts that are likely to present conceptual challenges to students.	
2. Planning	Developing a plan for the research tutorial; deciding on the approach to facilitate the research tutorial and its justification; deciding on data collection strategies; anticipating responding students' conceptual challenges using case students; thinking of ways to identify and respond to students' productive struggles; seeking ways of promoting dialogic talk between tutors and students.	
↓	**Between Phases 2 & 3**: Carefully considering the illustrational strategy to be used; performing trial runs of the data collection methods – as evidence of students' engagements and interactions; acclimatising students to the various data collection methods, for example, video-recording.	
3. Implementing	One tutor facilitates the research tutorial; one or two members observe and collect data on student learning using a pre-determined research instrument, for example, an observation guide; data is also collected through video-recordings and students' written samples, among others.	
↓	**Between Phases 3 & 4**: Researchers and tutors individually reflect on the activities accomplished by the research tutorial – by developing comments from notes made in the previous three phases of the research tutorial.	
4. Debriefing	Data collected by the tutors and researchers is analysed; discussions pertinent to student and tutor learning, in addition to pedagogical content learning, take place.	
↓	**Between Phases 4 & 1**: Evidence collected is used to inform decisions on: whether certain concepts in the research tutorial need to be re-taught; whether changes to the tutorial are required to make it more accessible to students.	
↑	Feedback on future research tutorial development, and TPD and student learning	

Figure 1.
Phases of a research tutorial.

course. Between Phases 1 and 2, tutors and researchers engage in brainstorming activities, where pertinent mathematical concepts and potential students' conceptual learning challenges are discussed.

Secondly, in the *planning phase*, the tutors and the researchers develop a plan for the research tutorial and why it should take a specific format, which is usually informed by the students' needs. Since research tutorials are evidence driven, tutors and researchers decide on the nature of the data collection strategies to be used. Part of the discussions look at how to anticipate and respond to the students' conceptual challenges using so-called 'case students'.

As defined in this chapter, case students are, for example, three students known to the tutors and the researchers, around whom the tutorial is planned. In other words, the planning phase looks at specific named students in a tutorial in each of the three categories: low, average, and high performers, and designs the tutorial around their needs. So, each of the tutorial planning activities is focused at addressing the needs of these case students, and by extension the rest of the students in the group [48, 59].

Part of the emphasis of the planning stage is on creating a learning environment that promotes the construct of dialogic talk, which requires tutors to use high order questioning that promotes critical thinking [60]—for example, Socratic questioning [61], and feedback that promotes alternative discourses [62, 63]. Pertinent characteristics of dialogic talk are: *collective*—an all-inclusive interaction between students and tutors; *reciprocal*—tutors and students listening to each other; *supportive*—tutors create an environment where individuals' views are valued and respected; *cumulative*—tutors and students create new and coherent lines of cognition by using each other's ideas as learning resources; and *purposeful*—tutors' and students' and/or group interactions are guided by students' educational needs and curriculum goals [2, 64]. This is contrary to studies on tutor-student interactions, which have found that classroom discourses are predominantly tutor-centred, in that tutors ask the questions and students respond, using short answers in the form of 'yes' or 'no' [65, 66], as in the case of classroom discourses observed in schools [67]. Between Phases 2 and 3, tutors and researchers finalise their data collection strategies, by doing trial runs and preparing students for the implementation of the planned activities from Phase 2.

Thirdly, in the *implementation phase*, one of the tutors facilitates the tutorials, using the guidelines established in Phase 2; the tutorial activities are both video- and audio-recorded. The other tutors and the researchers act as observers, using a pre-determined observation guide to monitor student-tutor and student-student interactions. Samples of the students' work are also collected as evidence for the students' ways of working. The facilitator and the observers keep a keen interest on the three case students' interactions, and predictions are made on how they are likely to perform during the research tutorial. Between Phases 3 and 4, tutors and researchers reflect on the accomplishments of the research tutor during the implementation phase and on the research tutorial in general—this is done informally, and by developing and sharing notes made during the previous three phases.

Fourthly, during the *debriefing phase*, tutors and researchers hold a post-research tutorial meeting, where data collected, and notes made during the previous three phases—setting goals, planning and implementation—are analysed. In addition, it includes discussions pertinent to the research tutorial itself, such as: classroom discourses, student and tutor learning moments and/or strategies, accomplishment of learning, and meeting of curriculum goals. Discussions around the three case students take place, looking specifically at whether the predictions about their interactions were correct. Between research tutorial Phases 4 and 1, evidence collected in the previous four phases is used by tutors and researchers to inform decisions on:

whether selected concepts in the research tutorial need to be re-taught; whether changes to the tutorial are required to make it more accessible to students; whether new strategies to improve deep learning should be pursued; and how interactions and engagement by students and tutors in research tutorial classroom practices can be enhanced.

5. The operationalisation of a research tutorial

Having presented the research tutorial framework in the previous section, in this section the discussion centres on how the framework can be operationalised in a Humanities first year undergraduate QL course with a specific research tutorial on the *percentage change* concept—see appendix. According to the research tutorial framework, the participants in the operationalisation of the tutor training are: three researchers, five tutors—all postgraduate students, and a research assistant. All participants take part in all the research tutorial activities. While the research tutorial posed two questions, the focus of the discussion in this chapter is on question 1 only, as shown in the appendix.

Students enrolled in this QL course mainly do Psychology as a major; however, students from other social sciences disciplines, such as social work, are also admitted to the course. Readers need to note that the majority of the students who enrolled in the QL course obtained low grades in their final year of high school and are characterised by their low interest in mathematics or learning activities that require an understanding of numbers and their applications. The construct of QL embodies 'the ability to understand, interpret, evaluate, and apply numerical [mathematical and statistical] data, as well as the ability to communicate mathematical ideas in various formats' [68]. On a practical level, QL promotes quantitative reasoning and logical thinking that assist students when dealing with quantitative issues, both in their discipline and in the real world, as informed, literate, and democratic citizens. Using the research tutorial shown in the appendix as an example, the following section illustrates how the four research tutorial phases—setting goals, planning, implementation, and debriefing—can be used for tutor training or TPD.

Firstly, in the *setting goals phase*, the curriculum goals of the topic, viz. *percentage changes*, is partly introduced during the orientation and induction of the tutors. The specific curriculum goals of the research tutorial are discussed in detail for each tutorial. For instance, in this research tutorial, the objectives of the research tutorial are: *calculate a percentage change and use growth factors to find quantities before and after an increase; read percentage changes from charts, tables, and texts; interpret charts in terms of percentage changes; communicate information about percentage changes—by writing statements describing the percentage changes in context; and calculate the orders of magnitudes.* These research tutorial objectives were agreed upon with an inter-rater reliability of above 90%; in other words, a consensus was reached by tutors and researchers that these were indeed the key objective of the tutorial.

Secondly, in the *planning stage*, which is about planning for data collection, one of the tutors, for example, asked the question: 'How do I address the students' productive struggles within the context of the tutorial objectives?'. In this stage, the research tutorial is also observed from the students' perspective, i.e. 'now as the student you will be trying to grapple with percentage change concepts from the tutorial to make sense of certain issues being raised ... and [look at how] the tutors respond to the students' [researcher]. During the planning stage, tutors recorded that question 1 (c) read: 'What was the percentage change in murder figures from 2005/6 to

2006/7 for Mpumalanga and Northern Cape?' And that this should be scaffolded to its current form—see appendix. This scaffolding was intended to allow a better understanding of the question by the students. In addition, the observers also focused on the extent to which the tutor accomplishes the objectives and the nature of students-tutor interactions.

Thirdly, in the *implementation phase,* in this research tutorial one tutor facilitates, another tutor acts as an observer, and a research assistant acts as a second observer; all tutor-student interactions are recorded. By 'attending'—recognising and/or noticing, identifying, and responding to the students' productive struggles on the concept of percentage changes—tutors sought to address the tutorial objectives [69–71]. In other words, the construct of the mathematical noticing framework includes: attending to, interpreting, and deciding how the tutor's responses to the students' productive struggles plays a critical role during the facilitation of the research tutorial [72]. The research assistant posits that, 'Students seem confused on all the information necessary to include in a definition as in question 1 (a)'. In response, the tutor tells students to 'look at the title of the chart and try to answer the questions: who? what? where?—and when?' [tutor] [73]. Part of the students' productive struggles can be attributed to a 'sense or meaning making', i.e. uncertainty in explaining, and expressing misconceptions and errors [74–76]. For instance, a student displays a misconception in question 1 (c) (ii): 'students think that using the percentage change, she/he can conclude that there were more murders in the Northern Cape than Mpumalanga' [observer]. When asked by the tutor to explain his/her answer, the student responded that, 'Mpumalanga had a decrease while the Northern Cape has had an increase in the amount of murders'. The tutor used directed guidance, by asking leading questions to get students to explain their reasoning; for example, in question 1 (c) (ii), the tutor asked the student why she/he chose yes, even though that was the incorrect answer [73]. These are just a few examples of the student-tutor interactions that took place during the implementation of the research tutorial. The three case students were monitored; one tutor posited that 'the predictions of the three case students were correct, since all of them performed as anticipated' [tutor]. Studies have shown that the tutors' [teachers'] predictions about case students are usually incorrect, probably because the tutors poorly assessed the case students [48].

Lastly, the *debriefing phase* constitutes the reflections on the research tutorial by both the tutors and the researchers, looking at how the data collected can inform and improve both student learning and tutoring on the concept of percentage. Students' productive struggles were specifically experienced in respect of question 1 (h). Tutors' reflections acknowledge that 'Question 1 (h) presented the most uncertainty for students. All of them struggled with the mathematical conceptual understanding of the question' [tutor]. Students appeared to have a misconception that they could just find an average of the nine provinces' percentages given to find the overall murder percentage of South Africa—this was a misconception because students were failing to understand that the provincial percentages and the national percentage (3.6%) were calculated using different absolute totals. Evidence collected during the implementation phase of the research tutorial showed that, even where scaffolding was done, students still found it challenging to understand the application of growth factors—derived from percentage changes, and to use them to solve authentic real word problems. While none of the tutors suggested that the research tutorial should be re-taught, tutors were concerned about the misconceptions and errors students had shown during the tutorial. In the main, the tutors recommended that the students needed more practical exercises on solving problems relating to growth factors, particularly where real-world contexts are concerned.

From this illustrative example of a specific QL-based research tutorial on percentage changes, the cyclical characteristic of the research tutorial can be observed. While this example is based on a research tutorial, the framework can also be applied to subsequent tutorials, thus adding to continuity within the TPD. The author is not claiming that the research tutorial framework proposed in this chapter addresses all the challenges associated with students' lack of engagement during tutorials but does posit that it provides an alternative approach to tutor training, an area that is under-researched in higher education disciplines.

6. Conclusion

Tutoring and tutor training by using a research tutorial framework, as proposed in this chapter, are critical components of higher education learning and teaching that are intrinsically linked to the students' deep learning strategies, in other words, meaning-making and development of complex conceptualisation of discipline content, which lead to enhanced student engagements and interactions during learning, improved throughputs, and greater access [77, 78]. The tutor training discussed in this study, through the use of a research tutorial, seeks to address discipline-specific skills development of tutors in an undergraduate QL course, and does not address 'generic tutoring skills such as presentation skills, taking control of a tutorial session and responding in an emotionally responsible and mature manner to students' requests and actions' ([79], p. 29). Discipline-specific skills development includes but is not limited to: mastery of disciplinary content knowledge—QL content; supporting students' productive struggles within the discipline content; designing and implementing new instructional strategies during tutorials; and promoting mathematical and statistical classroom discourses during tutorials. As demonstrated in this chapter, TPD by means of an evidence-driven research tutorial can have huge implications for promoting students' active engagements and supporting their productive struggles during learning. The author argues that the role of tutors has become more complex, given the diversity and unpreparedness of the students enrolled in higher education institutions. Given also that there is an expectation for tutors to use student-centred alternative approaches, and that most of the tutors are postgraduate students without formal tutor training, there is a strong need for university departments to develop TPD, like the one described in this chapter. In conclusion, there is a need to research the effectiveness of the research tutorial as an alternative TPD method, with a focus on disciplinary content and classroom discourses. In addition, future research should include focussing on how tutors notice, and attend to the students' productive struggles during an undergraduate QL tutorial through deep questioning.

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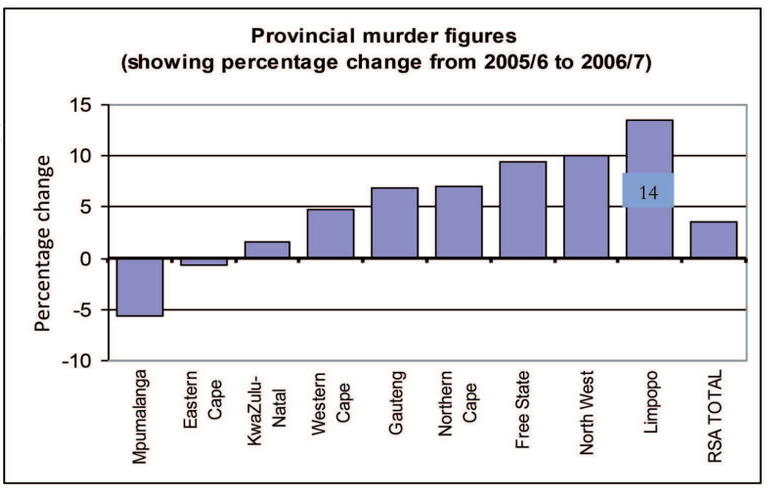
Conflict of interest

The author declares that no conflict of interest exists.

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Appendix: Research tutorial—percentage change

The chart below has been adapted from data in *The Annual Report of the South African Police Service for 2006/2007*. The questions relate to the chart and to the table alongside.



Provincial murder figures	
PROVINCE	**2006/7**
Mpumalanga	
Eastern Cape	3 705
Western	2 881
Gauteng	3 666
Northern	400
Free State	
RSA TOTAL	**19 202**

a. Describe in full the meaning of the number 14 in the bar on the chart.

b. Consider the following statements based on the chart and select the one that best describes the value for the Western Cape:

   i. The percentage change in murder figures in the Western Cape from 2005/6 to 2006/7 was more than 4%.

   ii. The percentage change in murder figures in the Western Cape from 2005/6 to 2006/7 was almost 5%.

c. What was the percentage change in murder figures from 2005/6 to 2006/7 for Mpumalanga and Northern Cape?

   i. In each case say what this means about how the number of murders has changed in the province.

   ii. Can you use the answer in (i) to conclude that there were more murders in the Northern Cape than in Mpumalanga?

d. Which province had the smallest percentage change (irrespective of the sign) in murders? What is the percentage change for this province?

e. It is known that the number of murders in the Free State in 2005/6 was 876. How many murders were there in 2006/7?

f. It is known that the number of murders in Mpumalanga in 2005/6 was 874. How many murders were there in 2006/7?

g. How many murders were there in Gauteng in 2005/6?

h. The percentage change for RSA is given as 3.6%. Is this value the average for the percentage change values for the nine provinces?

If yes, confirm the calculation of the value. If no, say how the figure of 3.6% would have been calculated.

i. What proportion of all murders in 2006/7 was committed in the Western Cape? Express the answer as a percentage.

j. In 2006/7 how many times as big was the number of murders in South Africa as the number of murders in the Northern Cape? Write your answer as a whole number.

i. Complete the proportion in the following sentence:

ii. The Northern Cape had only ⅏ of all murders in South Africa in 2006/7.

c. By how many orders of magnitude was the Eastern Cape's number of murders in 2006/7 bigger than that of the Northern Cape?

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