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Comparative Analysis of Mathematics Syllabi for Secondary School and Teacher Training Programs

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ABSTRACT Delivering competent teachers for the teaching of mathematics and science remains an ongoing challenge in South Africa. This study aims at comparing the mathematics syllabi for high/secondary schools and bachelor of education degrees in the country and tries to establish any discrepancies between them. A cluster sample was drawn from two universities in the province of KwaZulu-Natal. The method of content analysis was used to collect and analyze data. The coded data was quantified to determine the frequency of occurrence and the intensity of common and different themes. The principal observation indicated a distinctive overlap between the syllabi, but also showed that the teacher training syllabus goes far beyond the high school syllabus. The study concludes with recommendations for further research to investigate the proportions of pedagogical content and academic mathematics content in teacher training programs.

INTRODUCTION

Teacher training programs are generally expected to produce individuals who are ready to teach (Modipane and Kibirige 2015). Education and training constitute the foundations for competent teaching practice. The need to train competent teachers has consistently grown since the introduction of the Norms and Standards for Educators (NSE) in 2001 (DoE 2000), after which the NSE was replaced in 2011 by a policy document entitled Minimum Requirements for Teacher Education Qualifications (MRTEQ) (DHET 2011). Because teacher training programs must comply with the MRTEQ, this document draws a portrait of the kind of teachers needed in South Africa. Alarmingly, there seems to be no consensus in respect of the core body of basic knowledge that pre-service teachers should be exposed to during training. Furthermore, education faculties for teachers in South Africa develop the syllabi that they teach to pre-service teachers (Carl 2008) and the public schools' syllabi are designed by the National Department of Basic Education (DBE). The terms secondary and high school are use interchangeable in this paper.

Universities sometimes follow the integrated model as advocated by the NSE (Sibaya and Sibaya 2008), in terms of which pre-service teachers major both in academic content and in methods in the Faculty of Education. In certain universities, pre-service teachers do their majors in the respective faculties and their education courses in the Faculty of Education. Hoadley (2009) indicates that subject education is not emphasized in faculties other than the Faculty of Education. The opposite is true with regard to mathematics.

According to Wu (1999), there is often uncertainty about whether mathematics for teacher preparation courses should be within the boundaries of high school content, with little emphasis on advanced aspects, or whether it should be based on advanced tertiary mathematics. In Italy, the mathematics content offered to pre-service teachers includes those parts of school mathematics that are revisited at an advanced level (Furinghetti 2000). According to Furinghetti (2000), such a strategy is very good for mathematics teacher training, but it needs to be supported by the inclusion of a didactic component and appropriate methodologies. Didactics connect disciplinary and pedagogical knowledge, which enhance students' concep-

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tual understanding of the core knowledge required in the practice of teaching. It is generally surmised by present day researchers that teacher training programs must equip teacher trainees with analytic skills (Wu 1999; Furinghetti 2000; Ball and Bass 2003). Purportedly, teachers who view topics from an analytical perspective will explain the concepts contained in the content to the learners even beyond the prescriptions of the syllabus, which could enhance the learners' understanding of mathematics. Although Wu (1999) and Furinghetti (2000) conducted their studies in California (USA) and Italy respectively, they support the views that there is a need to carve out solid middle grounds between high school content and advanced tertiary mathematics, as well as to tackle school mathematics at an advanced level. What is considered by academics as good mathematics should have a solid link with the syllabus for immediate use by learners.

In exploring areas that might be connected with poor mathematics results, few (if any) studies have been conducted to determine the extent of the relationship between mathematics content covered by South African pre-service teachers during their training and the content they are expected to teach at high school when they begin their teaching career. Studies that have appeared in this field of research focus mainly on teachers' beliefs about the methods to be used in teaching mathematics (Gleeson 2015; Hasni and Potvin 2015; Isiksal-Bostan et al. 2015).

In response to teachers' plea for guidance and direction regarding how to teach their specific subjects, the South African Department of Basic Education recently contemplated the introduction of a subject-specific pedagogical approach (Du Toit and Booyse 2015), as such an approach is expected to revive the teaching of mathematics. Pedagogical guidance is what is lacking in the teaching of mathematics to teacher trainees. Compared to the rest of the world, South Africa has fallen behind in respect of mathematics and science performance. The absence of highly qualified competent teachers in these subjects is perceived as one of the main factors that contribute to students' poor achievement in mathematics (Howie 2003; van der Sandt and Niewoudt 2003; Van der et al. 2006; Van der Walt and Maree 2007).

Ball and Bass (2003) who were involved in a project intended to understand teachers' knowledge of mathematics better, maintained that teachers need to be adept at interpreting concepts for learners. This they cannot do if their own knowledge of high school mathematics is weak. Brijlall and Maharaj (2014) also confirm the views expressed by Ball and Bass about teachers' mathematics knowledge. According to Toh (2007), and Ramnarain and Fortus (2013), good teaching entails a deep and comprehensive knowledge of both content and pedagogy, and a clear understanding of alternative ways to present that knowledge effectively to students. A deep and comprehensive knowledge of content goes beyond knowing facts and procedures, and it involves knowing concepts, the connection between concepts, and alternative ways of how to impart that knowledge to learners. It is also necessary to investigate the syllabus of teacher training courses in mathematics, as well as how it corresponds with mathematics content in teacher preparation programs and the content teachers are expected to teach in high school.

The NSE did not stipulate how educators or teachers could be made competent (DoE 2000). However, for a teacher training institution to produce effective teachers, its learning programs must be action oriented as well as practice oriented (Witterholt et al. 2012). Braun (2015) observes that student performance increases tremendously in science and mathematics when learning is action oriented. It means that learning programs must encourage enquiry-based teaching and use analogies, illustrations, examples and demonstrations to enhance the understanding of learners. Teacher training institutions must therefore ensure that their programs offer a strong and coherent knowledge base for school mathematics. Pre-service teachers are also trained in the discipline of mathematics, and hence they need to understand its fundamental principles (Mnguni 2013).

Avalos et al. (2010) examined the knowledge base of first-year, third-year and final-year mathematics pre-service teachers at six teacher education institutions in Chile. They found that fifty percent of the final-year students responded correctly to mathematics questions, forty percent performed well in geometry and algebra, and only thirty-two percent were able to answer questions on mathematics pedagogy. From these results, Avalos et al. (2010) concluded that pre-service teachers might find it difficult to teach mathematics in all the grades they would be expected to teach. This could imply that there is a need to entrench the links between teacher-preparation mathematics and high school mathematics.

The researchers of this paper felt that it was compelling to conduct the present study. The researchers' main concern is to explore the relationship between mathematics syllabi for secondary schools and teacher training programs. Is there a continuity or disconnectedness between the two syllabi? Advanced university mathematics is often theoretical and abstract, which may elevate it above high school learners' understanding (Kyriacou et al. 2015; Pearce et al. 2015). In addition, as Brodie (2004) observes, mathematics as practiced by mathematicians is different from mathematics as practiced in schools. One reason for this is that high school mathematics is sometimes recontextualized and it lacks abstract manipulations. Pre-service teachers should therefore be taught advanced mathematics that is specifically aimed at providing a broad base for problem solving at the high school level.

Furinghetti (2000) argues that if there is little or no connection between university and high school mathematics content, pre-service teachers have no option but to evoke their school experiences and revert to teaching the way they themselves were taught in secondary school. Based on this argument, the Conference Board of Mathematical Sciences (CBMS) (2001) and Shoaf (2000) suggest that the core mathematics major courses at universities in general should be designed in such a way that pre-service teachers can make insightful connections between the advanced mathematics they learnt and the high school mathematics that they will teach. It seems appropriate to integrate advanced mathematics with high school mathematics, particularly in South Africa where the mathematics syllabus keeps changing.

A significant example of the integration of mathematics content is observed in the work of California's Mathematics Professional Development Institutes (MPDIs). Their mathematics programs involved both mathematicians and mathematics educators in designing and implementing content-focused learning (Hill and Ball 2004) to ensure that at teacher training level, pre-service teachers would be able to make a good transition from high school to advanced tertiary mathematics. The teacher trainees acquired mathematical knowledge suitable for teaching as a result of having both common and specialized knowledge of the content. According to Witterholt et al. (2012), well-designed professional learning programs have the benefit that they enable teachers to address changes in teaching and learning seeing that curricula are adjusted over time (Wu 1999; Shoaf 2000; Sam 2005; Witterholt et al. 2012).

The theory on mathematics content knowledge (MCK) regards this as a pillar in the teaching of mathematics. As a result, it is essential for the mathematics program in teacher training to go beyond the high school content to include advanced mathematics that will equip teachers with a degree of conceptual sophistication (Shoaf 2000; CBMS 2001). The current study is underpinned by this theory.

Aim of the Study

The general aim of the present study was therefore to examine the relationship between the mathematics syllabi for high schools and for teacher training programs.

METHODOLOGY

A field study design was employed in this research and the mathematics content syllabi of high schools and universities were examined. The documents were scrutinized as the secondary sources of the researchers' information. The study also adopted a qualitative research approach. According to Creswell (2014), a qualitative research approach enables the researcher to explore and understand a central phenomenon. A qualitative research approach was important in this study because it enabled the researchers to understand whether there was any link or connection between the teacher preparation syllabus and the high school syllabus. Furthermore, a qualitative study enlightened the present researchers on whether the current state of the two syllabi had any effect on the teaching and learning of mathematics.

Participant Selection

The nature of this study required the application of a non-probability sampling procedure.

As a result, a purposive or judgmental sampling design was used in the selection of the sample (Kumar 2014). According to Devers and Frankel (2000) and Gray (2009), purposive sampling ensures that only those participants who meet the purposes of the investigation are targeted. In the case of the current study, this meant that only those universities that offered teacher training programs would be selected. Hence, data was collected from the two universities that offered teacher training programs in KwaZulu-Natal, South Africa.

Research Instruments and Data Collection Procedures

The secondary sources of study data were the mathematics teacher preparation programs from the two universities involved in the study and the Grade 10-12 mathematics syllabi from the DBE. These documents were appropriate because they contained all the mathematics topics covered in teacher preparation and at high school. The assumption was that similarity between what is taught in teacher education and what these students would eventually be teaching in high school is essential for effective teacher preparation. The syllabi were compared to determine the extent of correspondence or difference. The researchers tabulated and categorized the themes and sub-themes covered by both syllabi in algebra, trigonometry and geometry. The common and different themes were subsequently coded and quantified in order to facilitate comparison.

Data Analysis Procedures

It was appropriate for the purposes of the present study to use content analysis to examine the teacher trainees' mathematics syllabus. Content analysis went through the different stages as suggested by Jacob (2006) (Tables 1-3) and was done to illuminate commonalities and differences between the high school and teacher education syllabi for the three sections of mathematics, namely algebra, trigonometry and geometry. Several researchers have applied content analysis in their studies, which were related to present investigation (Cabrita et al. 2015; Gürlen 2015; Mugwisi et al. 2015).

The total number of common themes and the total number of different themes were calculated in order to gain an impression of commonality and diversity (Table 4). The researchers constructed frequency distribution tables in which they counted the number of sub-themes or topics that are covered exclusively at high school level. They did the same for university level to form the second column of frequency distribution. In the third column, the researchers placed the sub-themes that were found at both institutions. Finally, they summed up the entries row-wise in order to obtain the entries for the fourth column.

Procedures and Ethical Considerations

The researchers visited the selected universities and the offices of the Department of Basic Education to seek permission to conduct research and to request the mathematics syllabi for teacher education and for Grades 10-12, respectively. On commencement of the research, the participants were assured of their right to privacy and to be treated with sensitivity. Likewise, privacy and confidentiality were guaranteed to the participating institutions, and they were assured of their anonymity and that their data would be kept confidential. Permission was obtained from the education authorities to make use of their syllabi. Anonymity was guaranteed in all instances.

Rigors of the Study

The comparison of curricula or syllabi is not an unusual exercise in education. Demirtas et al. (2015) compared two versions of the mathematics curriculum for fifth grade, and their results indicated similarity between the two versions. Likewise, to compare the content coverage of these two levels of mathematics education, the present researchers developed a 4-column structural framework. The first column was for university content, the second for high school content, the third for similar or common themes, and the fourth was for the themes that differed. The researchers in the current study identified and coded the common and differing themes in the syllabi for high school and teacher preparation programs, and the researchers quantified the themes to facilitate the comparison by establishing the frequency and intensity of sub-themes.

RESULTS

Algebra Content

In the algebra section of the syllabi the researchers found 31 themes that were covered both at high school and at university (commonality). A further 21 themes were covered exclusively at university, while 16 themes were covered exclusively in high school (diversity). This means that the total number of mathematics themes covered by pre-service teachers at university was 52 while in high school there were 47 (commonality and diversity).

The commonality between the syllabi of the two levels of mathematics education indicates a similarity between algebra content covered in teacher preparation programs and at high school. According to the count in Table 1, altogether 52 algebra themes were expected to be covered by pre-service teachers at university. About 31 out of 52 (60%) of the themes done by pre-service teachers covered high school and university topics, while 21 out of 52 (40%) of the themes were covered by pre-service teachers beyond the high school level. This frequency count analysis reveals that the mathematics syllabus for teacher preparation went beyond high school level to include advanced mathematics. For example, forty percent of pre-service teachers' algebra content was found to be more advanced than high school algebra. Furthermore, the high proportion of high school algebra content in the pre-service teachers' syllabus indicated that pre-service teachers repeated most of the themes they had learnt at school level.

In addition to the 52 themes that pre-service teachers are expected to study at university, 16 other themes are worked through exclusively in high school. It is therefore assumed that pre-service teachers did these 16 themes when they were still in high school. The researchers combined the 52 themes done at university with the 16 themes studied in high school and concluded that at the end of the fourth year, pre-service teachers ought to have done 68 themes, starting from high school to the final year at university. The present researchers expressed the relationship between the content coverage in high school and during teacher training in percentages, therefore 52 themes constitute 76.5 percent. The themes done in high school make about 23.5 percent.

The results indicate that forty-six percent of the algebra expected to have been covered by pre-service teachers before they finish training is taught both in high school and at university. Almost a third (31%) of mathematics themes that pre-service teachers are expected to complete is exclusively university level advanced mathematics. About twenty-three percent of high school algebra themes are not repeated in the teacher training program.

Trigonometry Content

Altogether 16 themes deal with secondary school trigonometry. A comparison of the syllabi indicates that about 6 themes (38%) of trigonometry themes studied by pre-service teachers constitute a repetition of high school work. The remaining 10 themes (62%) are done exclusively at secondary school. This implies by the time pre-service teachers complete their teacher training program, they have covered all 16 themes in trigonometry (Table 2).

Geometry Content

In the geometry section, pre-service teachers are exposed to 14 themes. Of these 2 themes (14.3%) constitute university work exclusively. There were 9 themes (64.3%), which were done both at secondary school and university levels. About 3 themes (21.5%) were done at secondary school level and not repeated at university level (Table 3).

Summary of Content Analysis

The content analysis done in this study is summarized in Table 4. Table 4 shows algebra has a total frequency of 68 themes or topics to which the pre-service teachers were exposed. The exposure to trigonometry has 16 themes or topics, while geometry has 14 themes or topics. The intensity of these themes varied with the sections of mathematics. In the present study, the term "intensity" refers to the ratio of themes per section of mathematics to the total number of themes for all sections (98 themes). For example, the intensity of algebra is 69.4 percent, which is the greatest of the three sections of mathematics, followed by trigonometry with 16.3 percent and geometry with a lowest intensity of 14.3 percent.

Table 1: Algebra content for high school and university teacher education

Universities syllabi themes	*High school syllabus themes*	*Number of similar themes*	*Number of different themes*
Exponents: exponential laws, exponential equations, exponential functions, graphs, inverse functions	*Exponents:* exponential laws, **surds,** exponential equations, exponential functions, graphs and inverse functions	Five themes in common	One theme covered at high school only (surds)
Number System: **complex numbers, conjugates, polar form, De Moivres theorem,** *complete a square*	*Number System:* **rational numbers, recognition of non-real numbers,** *complete a square*	Only one theme in common	Four themes covered at university only. Two themes covered in high school only.
Logarithms: logarithmic laws, **including ln**, *equations*	*Logarithms:* **definitions,** *logarithmic laws, equations*	Two themes in common	One theme covered at university (ln). One theme (definition) covered in high school only.
Sequence and Series: sum of sequences, generalisations	*Number Patterns: sum of sequences, generalisations*, **prove conjectures, recursive formulae interpretations**	Two themes in common	Two themes covered in high school only.
Calculus:limits, continuity, **derivative of exponential and logarithmic functions,** *derive using rules,* **integration, differential equations**	*Calculus:limits, continuity*, **rate of change and average gradient derive from the first principle,** *using rules* **cubic graphs**	Three themes in common	Three themes covered at university only. Three themes covered in high school only.
Financial Mathematics: simple interest,compound interest,nominal and effective interest rates, **changing interest,** annuities	*Financial Mathematics:* simple and compound interest, **foreign exchange,** effective and nominal interest rates, annuities, **bonds, sinking fund, investments and loan options**	Four themes in common	One theme covered at university only. Four themes covered in high school only.
Statistics and Probability: Stem and leaf diagrams, mode, mean, median and standard deviation, **range, inter quartile range, variance,** relative frequency, **cumulative frequency, relative cumulative frequency, outliers,** skewedness of distribution, independent probability, tree diagram, central tendency and dispersion, regression	*Statistics and Probability:* sample size linked to mean, mode, median and standard deviation, stem and leaf diagram, normal distribution, compare relative frequency to probability, **dependant** and independent events, tree diagrams,**symmetric** vs. skewed data, central tendency and dispersion, **calculating correlation coefficient,** regression function	Twelve themes in common	Six themes covered at university only. Three themes covered in high school only.
mathematical modelling	*mathematical modelling*	One theme in common	
linear programming	*linear programming*	One theme in common	
matrix algebra and polynomial theory, piecewise functions, partial functions,trans cendental functions, Countability	None	None	All six themes covered at university.

Italics* indicate common themes; **bold indicates differing themes

Table 2: Trigonometry content for high school and university teacher education

Universities syllabi themes	*High school syllabus themes*	*Number of similar themes*	*Number of different themes*
trigonometric functions and inverse functions	**definition using similar "**$_s$**,***trigonometric functions and inverse functions,* **graphs, special angles, 2-D problems**	Two themes in common	Four themes different.
reduction formulae	*deduction formulae* **including negative angles**	One theme in common	One theme different.
trigonometric identities (derivation).	**derive** and use *identities*	One theme in common	One theme not common
trigonometric equationsgeneral solutions of trigonometric equations	*trigonometric equations, general solutions of trigonometric equations,* **sine, cosine and area rules, 3-D problems**	Two themes in common	Four themes different.

*Italics indicate common themes; **bold** indicates differing themes

Table 3: Geometry content for high school and university teacher education

Universities syllabi themes	*High school syllabus themes*	*Number of similar themes*	*Number of different themes*
Euclidean Geometry: Figures and shape geometry,**Spheres**	*Euclidean Geometry:* **polygons,** *theorems and proofs on quadrilaterals, circles,* **Pythagoras' theorem, proportionality and similarity**	Only two themes in common	Three themes covered at high school only and one theme covered at university only (spheres).
Coordinate Geometry: consolidation of high school topics on coordinate geometry, **conic sections**	*Coordinate Geometry:* equation of line, circle and tangent to circle Inclination of a line	Four themes in common	One theme (conic sections) covered at university only.
*Transformational Geometry:*consolidation of high school topics on transformations	*Transformational Geometry:*rotations around origin, enlargements, rigid transformations and enlargements	Four themes in common	

*Italics indicate common themes; **bold** indicates differing themes

Table 4: Frequency of mathematics themes

Mathematics section	*Distribution of themes across three levels of education*							
	Secondary school		*University*		*Both levels*		*Totals*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Algebra	16	(23)	21	(31)	31	(46)	68	(100)
Trigonometry	10	(62)	0	(0)	06	(38)	16	(100)
Geometry	03	(21.4)	02	(14.3)	09	(64.3)	14	(100)

DISCUSSION

The question addressed in this study is, *what is the relationship, if any, between the content covered in mathematics education teacher preparation programs and high school mathematics?* When the syllabi for teacher preparation and high school were compared, the findings revealed that the teacher preparation syllabus covers most of the high school mathematics content, and goes beyond it to enrich pre-service teachers with university mathematics in the four years of the Bachelor of Education (B.Ed.) degree. The results of this study (Table 1) indicate that forty-six percent of algebra in the teacher preparation syllabus is also found in the high school syllabus, while twenty-three percent is covered exclusively at high school. This means that altogether sixty-nine percent of the algebra content that pre-service teachers are exposed to falls within the boundaries of school mathematics.

The current findings also reveal that there are sub-topics covered exclusively at university and others covered exclusively at high school. In algebra, for example, logarithms and calculus were main topics covered both at high school and university level, but the concepts of natural logarithm (ln), integration and derivative of logarithmic functions were covered only at university level. This finding indicates a clear link between high school mathematics and teacher preparation programs. The research in hand therefore supports the recommendations of Shoaf (2000) and CBMS (2001) who assert that the core mathematics major courses for pre-service teachers need to make connections between the advanced mathematics taught at university and the high school mathematics. The extent of the relationship between high school and teacher preparation syllabi raises high expectations and the present researchers would, for example, have expected pre-service teachers to teach high school content effectively.

The findings of the present study furthermore reveal that the mathematics syllabi in the teacher preparation programs transcended high school mathematics to cover several advanced topics. For example, matrix algebra, polynomial theory, piecewise functions and transcendental functions are done only at the teacher preparation level, which indicates that the teacher preparation program syllabi take pre-service teachers to advanced level mathematics. The current research supports the suggestion by the CBMS (2001) that high school pre-service teachers should complete the equivalent of an undergraduate major in mathematics.

In trigonometry, it was found that all the themes in teacher preparation programs (Table 2) were also present in the high school syllabus. Hence, pre-service teachers repeat all the trigonometry they did at high school and one would expect that learners should perform well in this section. The contrary is however true (DBE 2014). Similarly, Cajindos (2005) found that the first-year college students at Divine Word College of Vigan achieved a poor level of performance in trigonometry.

In geometry (as in the case of algebra), certain topics were done exclusively at university. For example, spheres and conic sections were done only at the teacher preparation level to enrich teachers with content knowledge above high school level. This study revealed that 64.3 percent of geometry content was covered at both levels of education, that is, at high school and in teacher preparation, while 21.4 percent was taught exclusively at high school. This finding indicates that altogether 85.7 percent of the geometry content covered by pre-service teachers before they finish training is within the high school syllabus. Again, the researchers expected pre-service teachers to excel when teaching this section and consequently to improve their learners' performance.

The findings of this study show that there is generally a high correlation in content between South African teacher preparation in respect of mathematics programs and the country's high school mathematics syllabi. However, competent teaching of mathematics cannot be explained solely on the basis of the overlap between syllabi. Effective teaching and learning of mathematics is the function of several factors and it results from an interaction of proficiency in English, interests, beliefs and teaching methods (Cho et al. 2015; Hasni and Potvin 2015; Isiksal-Bostan et al. 2015).

CONCLUSION

The present study established the extent of overlap locally between the syllabi of two levels of mathematics education, that is, for teacher preparation and for high school mathematics. The adequacy of knowledge acquired by the pre-service teacher during training is underpinned by strong links between the teacher training program and what he/she is expected to teach to learners at high school. Pre-service teachers must be fully proficient in the content of the subject that they teach, and if a teacher consistently produces good results, it is presumed that he/she has been well trained. The remarkable similarity between the South African high school and teacher education mathematics syllabi creates an expectation of excellent training and preparation of pre-service teachers, and yet there seems to be no conspicuous improvement in learners' mathematics attainments. The present researchers consequently had to admit that overlapping syllabi are not the only factor to warrant good mathematics results. In fact, the syllabi do not by any means guarantee what goes on in the classroom.

RECOMMENDATIONS

In South Africa, the majority of pre-service teachers enter teacher education programs with low Grade 12 mathematics results. As a result, there is a serious need for teacher education programs to help pre-service teachers to acquire an in-depth and comprehensive knowledge of the high school mathematics content that they will be teaching when they finish their training. Although the researchers believe that the integration of advanced mathematics with high school mathematics is appropriate in the context of South Africa, teacher training programs must invest more time in the re-teaching of high school mathematics concepts.

On the basis of the above findings, the present researchers recommend further investigation into learners' poor attainment in mathematics at school. This study has opened up avenues for further research into the academic content that teachers should cover in their training. An attempt should be made to enrich pre-service teachers with mathematics knowledge beyond the high school level. An investigation into the proportion of pedagogical knowledge in relation to academic content knowledge is also recommended.

LIMITATIONS OF THE STUDY

The limitations of this study involved mainly methodological issues. Very few journal articles in South Africa deal with the subject content of mathematics and science at all levels of education. Furthermore, the sampling for the current study was designed in accordance with the resources available, and if the researchers were to compare all the teacher preparation mathematics syllabi in the country, the results could have been different.

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