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ABSTRACT One of the essentials of the Bachelor of Education teacher-training programmes is to cover all mathematics content that pre-service teachers will teach at high-school while also tackling selected mathematics topics at advanced or university level. This study aims to analyse and compare the content of high-school pre-service teachers and high-school mathematics syllabi in South Africa. To this end, content analysis of these mathematics syllabi was conducted. The coded data were quantified to determine the frequency and intensity of common and different themes. The results indicate that the syllabi do overlap between the teacher-training and high-school mathematics contents. The findings are discussed and implications for teaching high school mathematics are highlighted.

INTRODUCTION

Teacher training programmes are generally expected to produce individuals who are ready to teach. Sound education and training are the foundations of competent teaching practice. The need to train competent teachers has persistently grown since the introduction in 2001 of the Norms and Standards for Educators (NSE) (DoE, 2000). The NSE was then replaced by the policy document entitled Minimum Requirements for Teacher Education Qualifications (MRTEQ) (DoHET, 2011). Teacher training programmes must comply with MRTEQ. MRTEQ therefore draws a portrait of the kind of the teacher needed in the South Africa. The daunting factor is that there seems to be no commonly agreed upon core body of basic knowledge that pre-service teachers should be exposed to during training. South Africa's teacher education faculties have limited autonomy to develop the curricula that they teach to pre-service teachers because the public school curriculum is designed by the National Department of Basic Education (DBE).

Some universities follow the integrated model as it was advocated by NSE (Sibaya and Sibaya, 2008), in which pre-service teachers receive both academic content and methods in the Faculty of Education while in other universities pre-service teachers do their majors in appropriate Faculties and Education courses in the Faculty of Education. The research indicates that where an integrated approach is used, not enough disciplinary knowledge is taught and where majors are taken in appropriate Faculties, not enough school mathematics knowledge is taught (Hoadley, 2009). The institutions draw up the content syllabi of their own teachers' programmes in isolation, without communicating with one another about what each is doing (Carl, 2008). This means that teachers from different teacher training institutions have been exposed to different syllabi, not necessarily derived from those prescribed nationally for schools by the DBE.

Notwithstanding disparities that may exist in the syllabi for teacher education, pre-service teachers are expected to teach the standardised school mathematics content when they exit training. One reason for this is that the learners whom they will be teaching in schools will sit for the common examination, that is, the national examination. 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 pre-service teachers'mathematics content consists of the parts of school mathematics content which is revisited at advance level (Furinghetti, 2000). According to Furinghetti (2000), this seems to be very good for mathematics teacher training although it needs to be supported by inclusion of a didactic component and appropriate methodologies.

Revisiting school mathematics at advance level ensures that pre-service teachers now look at the school topics analytically, seeking understanding of the originality of the topic. Purportedly, teachers who view topics with an analytical perspective will explain the concepts of the content to the learners even beyond the prescript of the syllabus, which could enhance the learners' understanding of mathematics. Although Wu's study (1999) and Furinghetti's study (2000) were conducted in California, USA, and Italy respectively we support their views that there is a need to carve out solid middle ground between high-school content and advanced tertiary mathematics and to tackle school mathematics at an advance level. What is seen by academics as good mathematics and what the designers of the school mathematics syllabus consider of immediate use to learners need to be congruent.

In exploring areas that might be connected with the country's poor mathematics results, few if any studies have been conducted to ascertain 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. The present study therefore investigates the extent of alignment between the teacher training and high school mathematics syllabi.

LITERATURE REVIEW

According to Mnguni (2013), teachers are the main source of information for students, as a result they are perceived as one of the reasons for students' achievement in mathematics (Pournara, 2005; Van der Sandt & Niewoudt, 2003; Mji and Makgato, 2006; Van der Walt and Maree, 2007). However, little progress has been made towards a consensus on the question of what mathematics teachers need to know (Davis and Simmt, 2006; Dorfler, 2003). There is little if any documentation of the level of academic mathematics content underpinning teaching activities.

Ball and Bass (2003), who were involved in a project intended to understand teachers' knowledge of mathematics better, maintain that teachers need to be adept at interpreting concepts for learners, which they cannot do if their own knowledge of high school mathematics is weak. According to Toh (2007), Ramnarain and Fortus (2013), good teaching entails a deep and comprehensive knowledge of content as well as pedagogy and the understanding of alternative ways to present that knowledge effectively to students. Deep and comprehensive content knowledge goes beyond knowing facts and procedures, it involves knowing concepts, the connection between concepts, and alternative ways of how to impart that knowledge to the learners. The poor teaching and learning of mathematics in South

Africa has created uncertainty as to the adequacy of training, and the extent to which the mathematics programme for pre-service teachers and the one they are expected to teach in high school are sufficiently aligned.

For a teacher training institution to produce effective teachers its learning programmes must be active and practice orientated (Witterholt, Goedhart, Suhre, and Van Streun, 2012). It means that learning programmes must encourage enquiry-based teaching, and use analogies, illustrations, examples and demonstrations to enhance understanding to learners. However, the Norms and Standard for Educators (NSE) did not stipulate how educators or teachers could be made competent (DoE, 2000). Pre-service teachers are trained in the discipline of mathematics, so they need to understand its fundamental principles (Mnguni, 2013). Teacher training institutions must therefore ensure that their programmes offer a strong and coherent knowledge base for school mathematics. Avalos, Telezzand and Navarro (2010) examined the knowledge base of first, third and final year mathematics pre-service teachers at six teacher education institutions in Chile. They found that 50% of the final year students responded correctly to mathematics questions, 40% performed well in geometry and algebra and only 32% were able to answer questions on mathematics pedagogy. From these results Avalos *et al* concluded that pre-service teachers might find it difficult to teach mathematics in all the grades they were expected to teach. For the South African context, this could imply that the designers of teacher preparation programmes need to entrench the links between teacher preparation mathematics and high-school mathematics.

About the problem of discontinuity in the university preparation of mathematics teachers Furinghetti (2000:144) has this to say: “When the future teacher arrives at the university as a student, he/she has to deal with the problem of advanced mathematics which does not remind her/him of what he/she has learned in school. After having completing studies at the university, and then begins teaching in school, he/she is expected to teach traditional mathematics. He/she is alone in facing this task and what was studied in university becomes a distant memory so that he/she goes back to the personal school experience, in order to have a pattern of what to do”. The consequence is that when a teacher’s own school experience is not good enough, he/she will not teach the subject well. Furinghetti’s Italian study may be pertinent to the South African context, in which pre-service teachers learn advanced mathematics at university and after completing the course come back to teach at school level.

Discontinuity in learning between the school and tertiary levels leads to disconnections between pre-service teachers’ mathematics knowledge and what they do in practice, thereby hindering effective learning (Crespo, 2003). Advanced university mathematics is often theoretical and abstract, which may elevate it above high-school learners' understanding. In addition, as Brodie (2004) observes, mathematics as practised by mathematicians is different from mathematics as practised in schools. One reason is that school mathematics is re-contextualised and lacks abstract manipulations. Pre-service teachers should therefore be taught advanced mathematics specifically aimed at providing a broad base for problem-solving at 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 were taught in secondary school. Based on this argument, the Conference Board of the Mathematical Science (CBMS) (2001) and Shoaf (2000) suggest that the core mathematics major courses at universities in general need to be designed in such a way that pre-service teachers make insightful connections between the advanced mathematics they learn 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 integration of mathematics content is observed in California's Mathematics Professional Development Institutes (MPDIs), in which the mathematics programmes have 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 are able to make a good transition from high school to advanced tertiary mathematics. Hill and Ball further argue that teacher trainees would acquire mathematical knowledge for teaching as a result of having both common and specialized knowledge of content. The benefit of well-designed professional learning programmes is that they enable teachers to address changes in teaching and learning (Witterholt, Goedhart, Suhre and Van Streun, 2012) as curricula are adjusted over time

Carl (2008) notes that each university has limited autonomy to design its teacher education syllabi for mathematics. It means that there is no specific content prescribed for pre-service teachers. For example, Wu (1999) recommended the following prospective teacher mathematics syllabus: rational numbers, basic number theory, complex numbers, polynomials, solution of cubics by radicals, basic linear algebra, basic coordinate geometry including conic sections in two dimensions and planes and line in space, trigonometry including the sine-cosine addition theorems, probability, graph theory, basic theorems of calculus, basic statistics, Euclidean geometry, the concept of measurement in general, isometries of the plane, and 3-space and history of mathematics. Sam's study (2005) which compares the syllabi of four public universities, two in China and two in Malaysia, indicated that in all four universities mathematics teacher education programmes included six major areas of maths: calculus, linear algebra, probability, statistics, differential equations, and complex analysis. However there is a variation in terms of the number of credit hours assigned to each. In China, universities included geometry and mathematical modelling but Malaysia excluded these topics. Shoaf (2000), in Baylor university, USA, advocated a mathematics teacher preparation programme which takes in calculus, linear algebra, combinatories, mathematical statistics, geometry, abstract algebra and computer science. In addition to these courses, Baylor university belived that secondary pre-service teachers would be best prepared if their course includes modelling motion with parametric equations, exponential and logistic growth models, sequence and series, mathematical modelling through apications, data analysis and regression, problem solving, graph theory, abstract algebra, and geometry matrices.

Despite the little autonomy that universities have in designing mathematics syllabi, it is worth noting that there are topics which are common in the programmes of the the two teacher training institutions. The examples of these topics are calculus, linear algebra and statistics. Very often the significant difference in these programmes is in the depth in which each topic is covered and the level at which each topic is introduced.

METHODOLOGY

A case study research design was employed in this research. An examination of the mathematics content syllabi of high school and university was carried out. Documents of these two institutions were examined. These documents form the secondary sources of our information. The study adopts a qualitative research approach. Creswell (2007) explicates that qualitative research approach enables the researcher to explore and understand a central phenomenon. A qualitative research approach was important in this study because it would enable the researcher to understand whether there is any link or connection between the teacher preparation syllabus and the high school syllabus. Furthermore, it would enlighten us on whether the current state of the two syllabi has an effect on teaching and learning of mathematics.

Sample and Sampling Design

The nature of this study required us to use a non-probability sampling procedure. As a result a purposive sampling design was used in the selection of the sample (Behr, 1988). According to De Vos (2005), purposive sampling is based on the judgement of the researcher that a selected sample has typical elements which contain the most typical characteristics of the population. Furthermore, Devers and Frankel (2000) and Gray (2004) explain that if purposive sampling is used, only the participants who will fulfil the purpose of investigation are to be targeted. It means that only the universities which have teacher training programmes were to be selected. On this basis, data was collected from the two universities that offer teacher training programmes in KwaZulu Natal.

Research Instruments and Data Collection Procedures

The secondary sources of data were the mathematics teacher preparation programmes from the two universities in the study and 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 a similarity between what is taught in teacher education and what they would be teaching in high school is essential for effective teacher preparation. The comparison of the syllabi was done to determine the extent of similarity or difference. We tabulated and categorized the themes and sub-themes covered by both syllabi in algebra, trigonometry and geometry. The common and different themes were coded and quantified in order to facilitate comparison.

Data Analysis Procedures

The total number of common themes in relation to the total number of different themes was calculated and compared. Content analysis was done in order to give an illuminating view of the comparison of the high school and teacher education syllabi for the three sections of mathematics, namely algebra, trigonometry and geometry. According to Palmquist (1967), content analysis is used to determine the presence of concepts and themes within texts or sets of texts. Content analysis went through stages suggested by Jacob (2006) as in Table 4. We worked out the field of the study of mathematics, that is, algebra, trigonometry and geometry again. The objective data in the form of sub-themes had already been created. These sub-themes lent themselves to classification. We constructed frequency distribution tables in which we counted the number of sub-themes or topics that are covered exclusively at high school level. We did the same for university level to form the second column of frequency distribution. In the third column we placed the sub-themes that are done in both institutions. Finaly, we summed up the entries row-wise in order to obtain the entries for the fourth column.

Ethical Considerations

Ethical considerations protect the fundamental rights of participants, taking into account respect for privacy and confidentiality (Wiid and Diggines 2009). The researchers visited the selected universities and the office of the Department of Basic Education to seek permission to conduct research and to request the mathematics syllabi for teacher education and grade 10-12 respectively. When doing research the participants need to know that their privacy and sensitivity will be protected. As a result privacy and confidentiality were guaranteed to the participating institutions. The institutions were assured that the data would be handled with confidentiality and anonymity. The people visited responded positively to the researchers' requests.

RESULTS

To compare the content coverage of these two levels of mathematics education we 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 for the themes that differed. We identified and coded the common and differing themes in the syllabi for high-school and teacher preparation programmes, and we quantified the themes to facilitate the comparison by establishing the frequency and intensity of sub-themes.

Table 1 about here

In algebra there were 31 themes that were covered in both, the high school and university.There were a further 21 themes which were exclusively covered at university while 16 themes were exclusively covered in high school. It means that the total number of mathematics themes covered by pre-service teachers at university was 52 while in high school there were 47.

The commonality between the syllabi of the two levels of mathematics education indicates a similarity between algebra content covered in teacher preparation programmes and in high school. According to the count (Table 1) there is a total of 52 algebra themes expected to be covered by pre-service teachers at the university. About 31 out of 52, that is, 60% of themes done by pre-service teachers cover high school and university topics while 21 out of 52, that is, 40% themes are covered by pre-service teachers beyond the high school level. This frequency count analysis reveals that the teacher preparation mathematics syllabus goes beyond high-school level to include advanced mathematics. For example, 40% of pre-service teachers' algebra content is more advanced than high school algebra. The high proportion of the high-school algebra content in the pre-service teachers' syllabus indicates that pre-service teachers repeat most of the themes they themselves learnt at school level.

Notwithstanding the 52 themes that pre-service teachers are expected to cover at university, there are other 16 themes which are done exclusively at high school. As a result it is assumed that they did these when they were still at high school. When combining these 52 themes done at university and the 16 themes that are done at high school we conclude that at the end of the fourth year pre-service teachers ought to have covered 68 themes starting from high school to the final year at university. We express the relationship between the content coverage in high school and in the teacher taining in percentage figures as follows: In case of the themes that are done in both the university and high school, we multiplied the number of themes done by a hundred and divided by the total number of themes from high school to fourth year (sixty eight themes) and we found 46%. We did the same for the themes that are done exclusively at university. We found that 21 themes done at university are 31% of the algebra to be covered from high school to the fourth year at university. We multiply sixteen themes that are done exclusively at school by one hundred and divide by sixty eight we got 23%. The data are illustrated in Figure 1.

Figure 1 about here

The illustration indicates that forty six (46%) of the algebra expected to have been covered by pre-service teachers before they exit training is taught in both the high school and university. Thirty one percent (31%) of mathematics themes that pre-service teachers are expected to do is university level advanced mathematics and is done exclusively at university from first to fourth year of their training. Ideally, this would enrich the teachers with mathematics knowledge beyond the high school level. Although some mathematics themes that pre-service teachers do at high school are repeated during the teacher training it appears from the high school syllabus that 23% of the algebra themes are done by pre-service teachers before beginning their teaching career since the themes are done exclusively at high school. In other words these themes are not repeated during teacher training.

Table 2 about here

There are altogether 16 themes of trigonometry. The comparison of the syllabi indicates that about 38% of trigonometry themes covered by pre-service teachers are a repetition of high school work. Ten (62%) additional themes are done exclusively at high school. It means that pre-service teachers are expected to have covered the total of 16 themes when starting from high school to the fourth year at university. The data is expressed as a percentage by multiplying the number of themes done by a hundred divided by the total number of themes expected to have been covered from high school to the final year at university.

Figure 2 about here

Table 3 about here

In the geometry section nine themes were covered at both levels of education, only two themes were covered by the pre-service teachers exclusively at university, and three themes were covered exclusively at high school. The total number of themes at university therefore was 11 while at school there were 12. It means 9/11 or 82% of teacher preparation is a repetition of school work while 2/11 or 18% of teacher preparation is advanced level mathematics beyond high school level.

When we sum up the eleven themes done at university with the three themes done exclusively at school we find a total of fourteen themes. Apparently, this is the amount of work expected to have been covered by pre-service teachers from high school to the fourth year of the teacher training. The relationship between high school and teacher training content coverage is then expressed in percentage terms as follows: we multiplied the number of themes done in each level by a hundred and divided by the total number of geometry themes expected to have been covered from high school to final year at university. For example, nine multiplied by one hundred divided by fourteen yields 64.3%. This result indicates that during the teacher training, pre-service teachers repeat 64.3% of the geometry themes which they did when they were still at school. At least 14.3% of the themes done by pre-service teachers during their training is the advanced geometry which is at university level. Furthermore, the results indicate that pre-service teachers covered 21.4% of the themes when they were still at school. This data is illustrated in the bar graph below.

Figure 3 about here

Table 4 shows the summary of the content analysis done in this study. Content analysis assumes that it is possible to identify content in terms of units (David & Sutton, 2004). We categorised the data in tabular form and identified units of data belonging to each category. We counted the units to determine how many of each type of unit could be found in the content (David & Sutton, 2004).

Table 4 about here

Table 4 shows that algebra has a total frequency of 68 topics or themes (including high-school and university content topics) to which the pre-service teachers were exposed before commencing their teaching career. The intensity of the themes to which the pre-service teachers were exposed varied with the sections of mathematics. In this study the term “intensity” is used to mean the ratio of themes per section of mathematics to the total number of themes for all sections. For example, the intensity of algebra is 69.4%, which is the greatest of the three sections of mathematics, followed by trigonometry with 16.3% and, finally, geometry with the lowest intensity of 14.3%.

DISCUSSION AND IMPLICATIONS

Speculation about the apparent poor teaching of mathematics by mathematics teachers, which results in a lack of mathematical literacy among South African learners, often raises various questions. For example, the question addressed here is “What is the relationship, if any, between the content covered in mathematics education teacher preparation programmes and high school mathematics?”

Comparing the syllabi for teacher preparation and high school, the findings reveal 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 course. The results of this study (Table 1) indicate that 46% of algebra in the teacher preparation syllabus is also found in the school syllabus while 23% is covered exclusively at school. This means that the total of 69% of algebra content that pre-service teachers are exposed to is within the boundaries of school mathematics. The findings reveal that in the same main themes/topics 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 at both high-school and university levels, but the concepts of “ln, integration and derivative of logarithmic functions” were covered only at university level. This finding indicates a link between high school mathematics and teacher preparation mathematics. The findings support the recommendations of Shoaf (2000) and CBMS (2001) that the core mathematics major courses for pre-service teachers need to make connections between the advanced mathematics that they learn and the high-school mathematics they will teach. The extent of the relationship between high school and teacher preparation syllabi raises high expectations and questions. For example, we would expect pre-service teachers to teach high school content effectively. However, the question is raised, “why do South African learners continue to perform poorly in mathematics?”

The findings of the present study also revealed that the mathematics syllabi in the teacher preparation programmes transcended high-school mathematics to cover several advanced topics. For example, matrix algebra, polynomial theory, piecewise functions, transcendental functions are done only at the teacher preparation level. This indicates that the teacher preparation programme syllabi take pre-service teachers to advanced level mathematics. The finding supports the CBMS (2001) suggestion 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 programmes (Table 2) were also present in the high school syllabus. It means that pre-service teachers repeat all that they did at school level. Ideally, this repetition ought to enhance pre-service teachers’ understanding of trigonometry concepts, but Biyela’s study (2012) indicated that pre-service teachers as well as high-school learners perform poorly in this section of mathematics. There is no documented evidence of the spectacular improvement of learners’ performance in this section of mathematics that one would expect.

As in the case of algebra, in geometry there are topics which 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% of geometry content is covered at both levels of education, that is, at high school and in teacher preparation, while 21.4% is done exclusively at high school level. This finding indicates that 85.7% of geometry content covered by pre-service teachers before they exit training is within the school syllabus. Again we expect pre-service teachers to excel when teaching this section, thus improving learners' performance. However, it seems that learners still perform poorly in geometry.

According to the findings of this study, there is generally a high correlation in content between South African teacher preparation programmes and the country's high-school mathematics syllabi but the learners' performance in mathematics remains poor. This has several possible explanations. For example, learners' poor performance can be attributed to inadequate content knowledge acquired by pre-service teachers during their teacher-training (Avalos et al. 2010). The adequacy of teacher training and preparedness of the teachers to teach a subject is often judged by the quality of results attained by learners in that subject. If a teacher consistently produces good results it means that s/he was well trained and vice versa.

Despite the remarkable similarity between the high-school and teacher education mathematics syllabi, there is prevailing poor attainment in South African mathematics education. This has implications with regard to either the pedagogical aspect or the level of teachers' content knowledge. Teachers pass on poorly understood content to learners (Pournara 2005; Lott & Souhrada, 2000) who then join the teaching profession again, thus creating a cycle of mediocrity. Pournara (2005) as well as Lott and Souhrada (2000) have reported that the majority of pre-service teachers join teacher education programmes with extremely low grade twelve mathematics results. This situation cannot be changed solely by the overlap between the school and teacher preparation syllabi because the syllabi do not guarantee what goes on in the classroom.

CONCLUSION

The study determined the extent of the overlap between the syllabi of the two levels of mathematics education, that is, the high school and the teacher preparation mathematics content. The results reveal a strong relationship between the high school and teacher preparation programme. However, despite the evident overlap between the high school and the teacher preparation syllabi the literature indicates that learners still perform poorly in mathematics and this raises concerns and speculation about the causes of poor performance in mathematics education.

The overlap in the syllabi presented here suggests that pre-service teachers cover most of the high-school themes in their training, which implies that they are in a position to consolidate what they learned in high school and what they will be teaching when they exit their training. This is meant to raise the chances of teaching the subject well, but in practice this is not the case. Instead, a revolving door effect is perpetuated, because teachers often produce learners who are incompetent in the subject and who later also join the teaching profession (DoE 2001). In analysing our results, therefore, we believe that despite the encouraging link between mathematics syllabi for teacher preparation and high-school learners, there remains a serious need for teacher education to advance pre-service teachers' existing mathematics knowledge and to create more effective pedagogical knowledge and skills (Brijlall and Maharaj, 2014). On the basis of the findings, we conclude that poor teaching of mathematics cannot be attributed to the relationship between the content of teacher preparation mathematics and that of high- school mathematics. The key to improving mathematics teaching may be lie with other factors which are not part of this study.

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TABLES AND FIGURES

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 ANDSERIES: *sum of sequences, generalizations,*	NUMBER PATTERNS: *sum of sequences, generalization*s, **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 averagegradient,derive from the firstprinciple**, *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 & effective interest rates, changing interest, annuities,	FINANCIAL MATHEMATICS: simple and compound interest, foreign exchange, Effective & 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,	STATISTICS AND PROBABILITY: sample size linked to	Twelve themes in common	Six themes covered at university only. Three themes covered in

mode, mean, median and standard deviation range, inter quartile range, variance,. Relative frequency, cumulative	mean, mode, median and standard deviation, stem and leaf diagram, normal distribution, compare		high school only
frequency, relative cumulative frequency, outliers, skewedness of distribution ,independent probability, tree diagram, central tendency and dispersion, regression	relative frequency to probability, dependant and independent events, tree diagrams, symmetric vs skewed data, central tendency and dispersion. calculate correlation coefficient, regression function,		
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, transcendental 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

University syllabi	High school syllabus	Number of similar	Number of

Themes	Themes	themes	different themes
trigonometric functions and inverse functions	**definition using similar Δ_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	**derive** and use *Identities*	One theme in common	One theme not common (derivation)
trigonometric equations general 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

University 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:	COORDINATE GEOMETRY:	Four themes in common	One theme, Conic sections covered at

consolidation of high school topics on coordinate geometry, conic sections	equation of line, circle and tangent to circle. inclination of a line		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 Sections N %	Themes exclusively done at High School N %	University N %	Themes common to both institutions	Total themes 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)

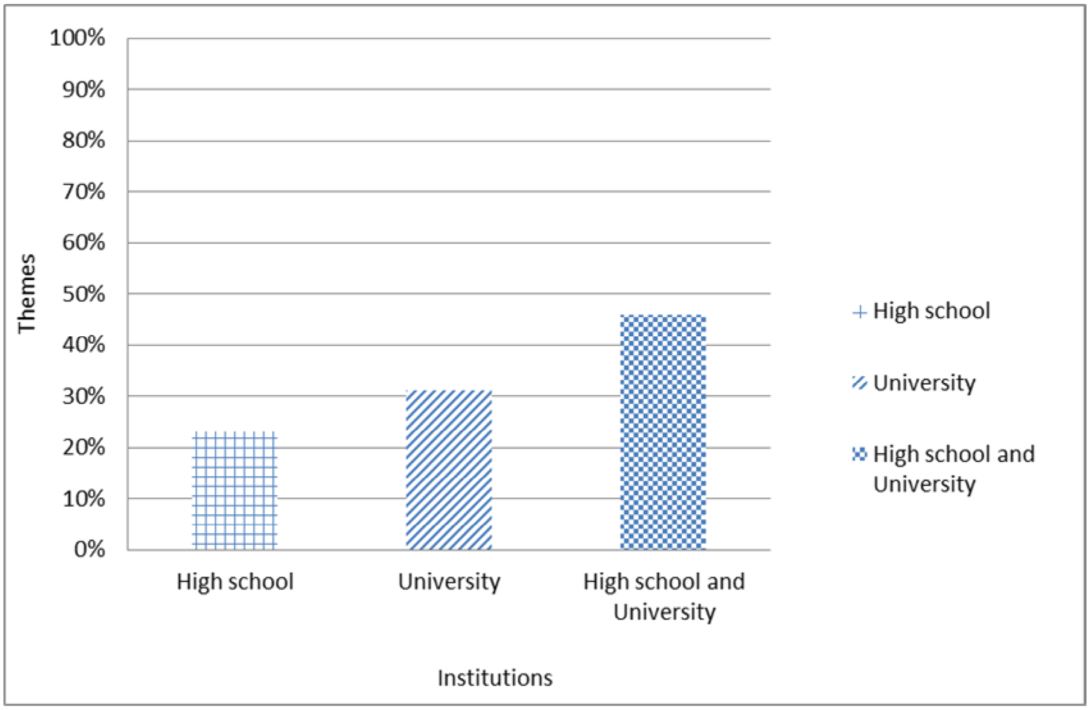

Figure 1: Degree of similarity between high school and university geometry syllabi

Figure 2: Degree of similarity between high school and university trigonometry syllabi