

TAU RESEARCH PROJECT

THE PREPARATION OF SECONDARY SCHOOL MATHEMATICS TEACHERS: THE EFFECT OF A CONTENT GAP COURSE ON PROSPECTIVE TEACHERS' SUBJECT CONTENT KNOWLEDGE: EVIDENCE FROM A SOUTH AFRICAN COMPREHENSIVE UNIVERSITY

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SUMMARY

This research reports a brief overview on the effect of a Content Gap Course on the Subject Content Knowledge (SCK) of a sample of 40 third year mathematics education students on selected topics in the senior secondary school mathematics curriculum of South Africa. The theoretical framework rests on theories on SCK of pre-service teachers. The research followed a positivist paradigm and pre-experimental design. Two tests on the selected topics before and after the Content Gap Course provided the data for the SCK for the study. The scripts were marked according to the memorandum and was further analysed using Microsoft Excel 2013. It was found that the prospective teachers had only limited SCK due to the curriculum constraints of the modules taught to them on the topics and that the Content Gap Course had a positive effect. This study recommends that acquiring the SCK is important for the students' success as an emerging teacher and effective teaching measures and changes in the teacher training curriculum of the university can be used as a tool to enhance the preparation of prospective teachers of the country.

AIM

South African education system has focused a great deal of time and attention on teacher preparation in the recent years. Teachers' content knowledge has a significant influence on student learning and academic success. South African government attaches a great deal of importance to the learning and teaching of mathematics in its school system due to its significant role plays in nation building. Teachers' mathematics content knowledge makes a difference in their instructional practice and their students' achievement. Wilburne and Long (2010) argue that many pre-service teachers find that they never had an opportunity to really study the middle or high school mathematics curriculum in depth, yet are expected to know the secondary mathematics content and be expected to teach it with meaning in their student teaching and beginning teaching experiences. According to Bukova-Güzel, Cantürk-Günhan, Kula, Özgür and Elçi (2013), content specific knowledge domains for mathematics teachers can be named as mathematics subject-matter knowledge, mathematics curriculum knowledge

and mathematical pedagogical content knowledge. Teaching strategies, content knowledge, understanding and motivation were some of the factors identified by Mji and Makgato (2006) on their study on the factors associated with the poor performance of South African learners in mathematics and physical sciences and they suggest that learners can be motivated towards the subject if educators are confident with respect to knowledge of the subjects they teach. It is also noted that preparing teachers to teach mathematics effectively is one of the most urgent problems facing those who wish to improve students' learning (Morris, Hiebert & Spitzer, 2009). Kriek and Grayson (2009) also assert that the poor state of mathematics and science education in South Africa can be attributed, in part, to many teachers' limited content knowledge, ineffective teaching approaches and unprofessional attitudes.

Research conducted mainly in the eastern parts of Eastern Cape (e.g., Siyepu, 2005; Alex, 2012) also inferred that the general poor quality of teachers and teaching are some of the factors that have contributed to the lacking in the necessary mathematical knowledge of disadvantaged learners from the impoverished learning environments and it is imperative to find solutions that will improve the quality of mathematics learning and teaching, especially in the rural part of the province. This study is significant as the researcher felt that being a teacher trainer, the SCK of the mathematics education students to be checked and corrected. The research question addressed in this research is: Can a Content Gap Course on prospective teachers improve their SCK on selected topics?

OUTCOME

This research adopted a positivist paradigm pre-experimental design (one group pre-test post-test design) and a quantitative approach. The sample consisted of a group third year university Bachelor of Education (Mathematics Education) cohort of 40 students of the South African Comprehensive Public University. All the ethical requirements were met. Two question papers which were purposively selected from a standardised question Paper of Matric Examination of 2014 of which, one consisting of seven questions on Financial Mathematics and Probability (Paper 1) and the other one consisting of 10 questions on Data Handling, Analytical Geometry, Trigonometry and Euclidean Geometry (Paper 2) provided the data for the SCK for the study. From the analysis of the pre-test it was found that the total mean percentage was 27% and that the prospective teachers had only limited SCK on the topics that they are meant to teach in the schools during their school based experience. It was also noted that the difficulties experienced by the students were similar to the ones experienced by the matric students as explained by the Chief Examiner's report of 2014 (DBE , 2015).

After seeing the performance of the students in the test, it was agreed that a content gap course can be arranged to address the low performance in certain topics. The classes were offered by the researcher after the normal lecturing hours of the students. Due to the constraints of time and the demand of the topics, classes were conducted for 8 weeks only for Financial Mathematics, Probability, Data Handling and Euclidean geometry. Analytical Geometry and Trigonometry were not included in the content gap course as the students deemed it as more manageable than the other demanding topics. The following table shows the performance of the students before and after the Content Gap Course.

Table 1: Students' SCK on selected topics: Performance comparison in the Diagnostic test and after the Content Gap Course

Topic	Pre-test (Mean %)	Post-test (Mean %)
Financial Maths	37	52
Probability	18	34
Data Handling	35	40
Analytical Geometry	37	45
Trigonometry	28	27
Euclidean Geometry	16	20
Total Paper 1	27	43
Total Paper 2	27	31

From Table 1, it is noted that the average percentages for Financial Mathematics increased from 37% to 52%, Probability increased from 18% to 34%, Data Handling increased from 35% from 40%, Analytical geometry increased from 37% to 45%, Euclidean Geometry increased from 16% to 20% and a decrease in Trigonometry was noted from 28% to 27%, and the total percentages for Paper 1 and Paper 2 separately increased from 27% to 43% and 31% respectively. It is also noted from the analysis that the average percentages for Financial Mathematics and Probability were considerably increased and the performance in Trigonometry was lower than the percentage of the pre-test. The analysis showed that the Content Gap Course had a positive effect in the topics that were very new to the students namely Financial Mathematics, Geometry and Probability.

A close examination on the content of the modules taught for the mathematics education was needed, as most of the students complained that the content needed in the school was lacking in their curriculum. It was done through document analysis. It was noted from the course modules that the mathematics content curriculum followed in the senior secondary schools was not stressed in the modules. Even though in the first year of study, senior secondary school mathematics was the content for their course modules, the students were not taught with the topics of Geometry and Probability as they were following a different curriculum at that time and during their third year of study, they had to teach the topics in schools as these topics were part of the new curriculum, which was not catered for in their modules.

Findings and conclusions

It is noted that the prospective teachers had only limited subject content knowledge (SCK) on the topics that they were meant to teach in the schools of which some of the topics were not even included in the university's teacher education curriculum. They also experienced the same difficulties as the matric students of 2014. The Content Gap Course had a positive effect in topics that are very new to the prospective teachers which are mainly Financial Mathematics and Probability. Analytical Geometry was fairly attempted even though it was not taught during the Content Gap Course. Trigonometry was not taught during the Content Gap Course and there was a slight decline in the performance. The performance in Euclidean

geometry has a slight improvement and it still remained as the worst performing topic even after the Content Gap Course.

Recommendations

It is recommended that the curriculum of the university should include more opportunities for the mathematics education students to familiarise them with the school mathematics content. Acquiring the subject content knowledge is important for the students' success as an emerging teacher and effective teaching measures and changes in the teacher training curriculum of the university can be used as a tool to enhance the preparation of future teachers of the country.

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