The Impact of a Classroom Intervention on University Students' Learning in a Mathematics- and Statistics-related Subject

Danri Delport [1]
(ddelport@cut.ac.za)

Abstract

A growing number of underprepared students are entering higher education institutions and students' underachievement in mathematics is indeed of great concern. Numerous research studies have pointed out that the academic domain of underpreparedness among such students entails a lack of mathematical ability and effective study skills. Research also point out that education should focus on "learning how to learn" and that educators in South Africa should turn back to their primary responsibility, which is to teach learners necessary thinking skills. This study reports on the introduction of a classroom learning strategy that was designed to improve students' academic performance in a mathematics and statistics-related subject at the Central University of Technology, Free State. The study followed a non-equivalent pre-test post-test design involving an experimental group and control group of students. A quasi-experimental approach was used to determine whether the post-test performance of students who were exposed to the classroom learning strategy (experimental group) was higher than that of students who received no classroom learning strategy (control group) in the module *Business Statistics/Statistics II*. With regard to the qualitative mode of study, the researcher conducted a nominal group setting to determine the developmental experiences students found most useful after the implementation of the classroom learning strategy intervention. The quantitative analysis of students' post-test performance showed increases in students' academic performance in the module *Business Statistics/Statistics II*. The results that emerged from the nominal group technique setting also support the effectiveness of the researcher's proposed classroom learning strategy intervention, as it had a positive effect on students' attitudes regarding a mathematics and statistics-related subject.

Keywords: *underprepared students, mathematical ability, effective study skills, classroom learning strategy intervention*

1. INTRODUCTION

This article is concerned with university students' underachievement in a mathematics and statistics-related subject. The researcher attempted to develop a classroom learning strategy, aimed at improving students' academic performance in a mathematics and statistics-related subject at the Central University of Technology (CUT), Free State. The primary purpose of the research was to determine if the use of a classroom learning strategy intervention could positively affect students' academic performance and learning approaches in a mathematics and statistics-related subject.

[1] *Lecturer, Mathematics and Physical Sciences, Faculty of Engineering, Central University of Technology, Free State (CUT), South Africa*

2. LITERATURE REVIEW

The persistent problem of poor academic performance of many students at primary, secondary and tertiary level, particularly in mathematics, is disturbing. Underachievement is often highlighted as the single most significant impediment to mathematics failure in developing countries, including South-Africa [Moore (in Brussouw 2007:139; Mukadam (2009:4 of 5)]. For more than two decades now, concerns have been voiced about the profile of the school-leaving learner applying to enter universities in South-Africa, with an increasing number of students in the educational system who experience serious and persistent problems in interpreting and performing academic tasks. Steyn and De Boer (1998:125) purport that one of the outstanding features of underprepared students, is their inadequate schooling in mathematics and natural sciences. Given this situation, underachieving students in mathematics are in dire need of a repertoire of learning approaches, strategies and methods to cope with the demands of tertiary education (De Boer and van Rensburg 1997:160). As a result, considerable emphasis is placed on the contribution leaders and practitioners can make towards relieving the high levels of failure in mathematics.

According to Yusof and Tall (1999:67), the traditional methods of teaching mathematics at university often seem to lead students into a 'deficit mode' of rote-learning material to pass examinations. As a result, these procedural forms of thinking and working often prove to be resistant to change [Sierpinska, Schoenfeld and Williams (in Yusof & Tall 1999:67)]. Students learn the "product of mathematical thought" rather than the process of mathematical thinking [Skemp (in Yusof & Tall 1999:67)]. In agreement with Yusof and Tall (1999:67), Steyn and De Boer (1998:127) argue that one of the obstacles that the underprepared student must overcome is a surface approach to learning, which is associated with rote-learning. However, "[w]hen students feel a need to engage the task appropriately and meaningfully, they follow a deep approach to learning" (Biggs and Tang 2007:24).

According to Raab and Adam (2005:93), underprepared and first generation students often lack effective study skills. To address this concern, Cukras (2006:194) suggests that study skill courses as well as academic assistance programs should be designed. According to Abrams and Jernigan (in Potgieter & Webb 2004:313), the responsibility lies with higher education institutions to provide effective intervention strategies to help with the retention of underprepared students. Leaders in higher education today need to understand the shift in knowledge structures and the changing framework of learning and teaching, especially with the transformational change in South African society. These changes from the traditional to the new paradigm in higher education are crucial in developing countries such as those in South Africa to solve long-standing underachievement and consequent failure rates in mathematics. However, professionals and practitioners in the academic arena often find it hard to make these changes effectively and efficiently, because they often lack the "know-how".

Given the importance of and emphasis on study skills in mathematics in the academic arena, this is a cause for concern. According to Mr Japie Gouws, executive director of the ATKV (Die Volksblad 2009d:10), study skill development has often in the past not focused enough on the development of effective study skills in mathematics.

The research on which this article is based, attempts to provide a possible solution for filling this gap and to make available to novice and experienced lecturers a 'tool' which may contribute to students' learning in a mathematics and statistics-related subject. This article reports on research conducted to investigate the implementation of a classroom learning strategy intervention for a mathematics and statistics-related subject at the CUT. The main purpose of this pilot study was to determine whether the use of a classroom learning strategy intervention could positively affect first-year students' academic performance as well as students' learning approaches in the module *Business Calculations* at the CUT.

3. RESEARCH DESIGN

This study is located within a quantitative paradigm, with some enhancement by means of qualitative observations of student's problem-solving approaches. In the qualitative mode of the study the researcher collected information with regard to students' problem-solving approaches and techniques by means of a reflection diary.

An experimental, quantitative approach was used when attempting to answer the question whether the test scores of students who have been exposed to the learning strategy intervention were any different to those of students who received only traditional instruction, with no intervention of the learning strategy.

A group of first-year students at the CUT was selected for the pilot study of the research project. A sample of 139 first-year students were selected from the total population (N=177) of students who were enrolled for the National Higher Certificates in Financial Information Systems, and Accountancy, at the CUT. The students from both courses formed part of two intact classes of students who took *Business Calculations* (BCL11AB) as a compulsory module. The students were all registered as full-time students on campus and attended BCL11AB classes three times per week over a period of six months during the first semester of the 2009 academic year.

A non-probability sampling method was employed, as the researcher did not make use of a random selection of participants. The researcher used convenience sampling, and more specifically wholeframe sampling, as the subjects were available and formed part of the lecturer's (who is also the researcher) classes (McMillan & Schumacher 2006:125).

The study followed a non-equivalent pre-test post-test control group design involving an experimental group and a control group (Leedy & Ormrod 2001:236; McMillan & Schumacher 2006:273). The students (n=50) who were enrolled for the National Higher Certificate in Financial Information Systems served as the experimental group and were taught following the proposed classroom learning strategy intervention. The students (n=89) who were enrolled for the National Higher Certificate in Accountancy served as the control group and received traditional instruction. Both groups of students attended two theory lectures twice a week and one tutorial once a week. The duration of each theory and tutorial lecture was 80 minutes. During the theory lectures, the lecturer explained the work to students and, during the tutorials, the students worked out exercises from the prescribed textbook. The researcher utilised the national prescribed syllabus for the module *Business Calculations* and strictly kept to the study guide. Both classes received exactly the same academic instruction (with different approaches) by the same lecturer, covered the same work content, and used the same prescribed textbook.

A quasi-experimental approach was therefore used in answering the question whether the *Business Calculations* test and exam results, as well as learning approaches of students who had been exposed to the proposed learning strategy intervention, were any different from those of students who were not exposed to the learning strategy intervention.

In an effort to investigate the research problem, the study has tested the following research hypotheses:

The first research hypothesis read as follows:

H_{01} : The post-test score in *Business Calculations* of the experimental group is equal to the post-test score of the control group.

H_{a1} : The post-test score in *Business Calculations* of the experimental group is significantly higher than the post-test score of the control group.

The second research hypothesis read as follows:

H_{02} : The mean difference score on the revised two-factor study process questionnaire (R-SPQ-2F) for the experimental group is equal to the mean difference score of the control group.

H_{a2} : The mean difference score on the revised two-factor study process questionnaire (R-SPQ-2F) for the experimental group is greater than the mean difference score of the control group.

For the purpose of this study, the researcher relied on numerical data (scores obtained from tests and the exam, as well as the R-SPQ-2F Questionnaire) to test the relationship between the variables as well as to test the formulated research hypotheses, i.e. whether the average post-test score in *Business Calculations* of the experimental group is higher than the average post-test score of the control group; and secondly, whether the mean difference score on the R-SPQ-2F Questionnaire for the experimental group is greater than the mean difference score of the control group. The results (scores) of the tests and exam were used in the study to assess the pre- and post-test performances of students in the module *Business Calculations*. The average post-test score was calculated by computing the average of the first post-test (post-test 1) and the second post-test (post-test 2). All results were compared to determine the effect the classroom learning strategy intervention had on the participants.

As this research involved the systematic collection of observable and measurable data as well as the statistical analysis of the data, the quantitative paradigm was considered appropriate for this study. In order to determine the effect of the proposed classroom learning strategy intervention on students' academic performance in the module *Business Calculations*, the quantitative data was collected by means of three self-developed instruments (two tests and one exam) intended to yield highly reliable and valid scores. The researcher also used the R-SPQ-2F Questionnaire by Biggs, Kember & Leung (2001:133) to gauge students' approaches to learning.

The quantitative data from students' scores in the pre-test and both post-tests were obtained by the researcher during the first semester of 2009 and entered into a database in which the results were analysed. Students were assessed during February, April and in the exam in May. The first class test of the BCL11AB semester subject served as the pre-test and was