PRINT: ISSN 0975-1122 ONLINE: 2456-6322
Int J Edu Sci, 11(2): 187-195 (2015)
DOI: 10.31901/24566322.2015/11.02.07

Improving Mathematics Learning and Teaching through Syllabus Change in a South African University Campus: ICT Leverage

Promise Tshepiso Molale and Solly Matshonisa Seeletse

Department of Statistics and Operations Research, Sefako Makgatho Health Sciences University, PO Box 107, Medunsa, 0204, Gauteng Province, South Africa

KEYWORDS Benchmark. Performance. Student Support. Technology

ABSTRACT This paper presents the investigated effect of curriculum change on student performance in first-year Mathematics (Math-1) modules at the Medunsa Campus of the University of Limpopo, South Africa. The change increased the syllabus scope intensely. However, when student examination marks in the old modules were compared with those of other students in the new modules, the latter showed improvements in average marks. However, larger variances were indicated, which is diverse performance. Exploration as to why higher performance was achieved showed that speed in lecturer facilitation and student practice by using technology was one reason. It was then left to improve uniformity in performance, which was thus recommended by the study.

INTRODUCTION

Mathematics Worth

Mathematics (Math) is the study of quality, structure, space, patterns, conjectures and facts by rigorous deduction from appropriately chosen axioms and definitions (Graham 2002). It is relevant in modern education, and is vital for permeating the daily lives of people globally. It is the foundation for modern inventions, scientific discoveries and research studies. Mastering basic mathematical skills aids to cope with life demands such as being numerically literate, gaining tools for employment, developing prerequisites for further education and appreciating the relationship between math and technology (Martin 2008). Also, mathematics is a language of the sciences. Many disciplines depend on math as a symbol for communication. Also, it develops the students' general decision-making and problem-solving skills (Lewis et al. 2001). Thus, more focus and research should be devoted to mathematics. Changes in the subject content should be smooth, and proper communication is needed.

The increased syllabus can lead to incompletion at the end of a term. However, the use of technology to facilitate and practice math exercises can increase the speed of subject delivery (Evangelista 2000). There are many versions of ICT that South African universities use to facilitate the learning for longer hours. These methods allow for new methods and content to support the prescribed syllabus content. Therefore, a syllabus increase can be backed by an ICT tool. ICT usage, mainly e-learning and the use of Internet in teaching have the benefits of increased coverage and speed when compared to normal teacher tell (Balanskat et al. 2006).

A mathematics curriculum change can lead to bad results. The teachers are often neither equipped nor prepared for the change. The change in math curriculum should help in effective teaching of the subject. A success in implementing a new math curriculum can be enhanced. Kilpatrick (2009) counsels that curriculum change should be a personal journey for the teachers. In Finland, severe drawbacks in the Finnish math curriculum occurred, and time allocated to different concepts and skills was inadequate (Martio 2009). The changes in the math curriculum were made to help people use it in everyday life, but the aim could not be realized.

Problem Statement

The original mathematics curriculum at the former Medical University of Southern Africa (Medunsa) was designed with the help of the Department of Mathematics of the University of Pretoria in 1988. This curriculum was used until 2004 when Medunsa merged with the former University of the North (also known as Turfloop campus) to form the University of Limpopo. The two Departments of Mathematics at Medunsa and Turfloop Campuses designed a new curriculum that would be consistent across the campuses. At the first level (Math-1 modules) the syllabus entailed combining the previous syllabi that were used at the two universities since each one involved an addition that increased their modules slightly.

The two syllabi were about ninety percent common. This means that the portion added for each module was about twenty percent, which is a slight increase. Often when the course content and scope increase, course demand usually increases while the pass rate decreases. However, at the Medunsa campus, the pass rates in Math-1 were suspected to have increased. This prompted a former student to investigate formally if the pass rates had increased and also investigate the fundamental causes of the increases. Interest was to use statistical tests, and to determine the nature of the changes. This paper is based on that research (Molale 2010). The tutors who were involved during the study period were given a short training on the syllabus aspects that were new because they had not done them at first year.

The study purpose was to evaluate the effect of the structural changes of the Math-1 curriculum on the students' academic performance. The objectives were:

- To evaluate the level of performance for both syllabi.
- To compare the performance of Math-1 students of 2005 to 2007 with Math-1 of 2008 to 2010.
- To determine how facilitation managed to prevent a decrease in performance after an increase in syllabus coverage.
- To evaluate the significance of success and failure on the structure of the curriculum.

Context

The campus of Medunsa of the University of Limpopo is located inside the former Medunsa. The natural sciences form a small percentage in a campus dominated by the health sciences (Dental Therapy, Medicine, Occupational Therapy and Physiotherapy). The management at this campus pays more attention to the health sciences and little to the natural sciences. Historically, this campus was once a medical school without the natural science focus. Few natural science courses of the first year level served to support the health sciences. In the late 1980s when Medunsa was fully focused on the health sciences, a need was identified that local communities needed the services of a university in the sciences. The sciences for educators in education were lacking. The faculty of basic sciences was established in year 1988 to fill this gap. However, the university still paid more attention to the health sciences. The natural sciences had to struggle for many years. This continued even after the formation of the University of Limpopo from the merger of the former Medunsa and the former University of the North. Nothing much changed to favor the sciences. The initial leadership of the school of pathology and pre-clinical sciences, which incorporated the basic sciences, also came from medicine. They did not appreciate that the sciences needed to be nurtured.

Another concern was that most students enrolled in the sciences were believed to be rejects of the sciences at other universities, and rejects of the health sciences because of their low matric results. Focus and concentration of student support was biased towards the health sciences. Management of the natural sciences is based at the Turfloop campus, about 300 km from the Medunsa campus. On the Medunsa campus there are mainly administrators who usually never commit to decisions in favor of academics in the natural sciences. Hence, the natural sciences are not visible enough due to lack of leadership on campus. As a result, academic personnel in the sciences have to produce enough results to demonstrate the existence of the sciences on this campus.

Mathematics is a popular subject in the natural sciences. Many students in the natural sciences take math-1 because most major subjects require math. The Math-1 pass rates were at some point low, until staff changes occurred in the department. During the high Math-1 failure rate era at Medunsa, the statistics courses also suffered because they depend on math prerequisites. Hence, both Mathematics and Statistics, among other science majors, could not have many postgraduate students. Furthermore, they both could not attract many students, as their value was not even promoted. The math lecturer observed the low math pass rates. As a former teacher, and having done research in math education, he focused on changing the mindsets of students in the sciences to realize the value of the subject.

This lecturer acknowledged in several research presentations that he struggled to shift the paradigms in the students' minds. This made math to be perceived as a barrier to a bachelor's degree attainment, and was also considered to be lacking value. After the merger, a harmonization of the programs was required. This happened, and apparently, the lecturer made some enquiries in South Africa, and contacted some international and overseas networks that assisted him in the curriculum development for the new Math-1 modules in both campuses.

The new syllabus was seen as aggressive and ambitious since it was seen to be much more demanding for the Medunsa students admitted to study the sciences. Some monitoring was placed in the delivery of the Math-1 modules. Seemingly, it was hoped or expected that the failure rate would drop dramatically. As a result, a close watch was kept on the development of the teaching and the results of Math-1.

Apparently, the first few years of offering new Math-1 modules were difficult. However, hard work was placed around facilitation. Tutors were introduced to support students enrolled for Math-1. External monitoring was also included in the modules. The use of information and communication technology (ICT) in teaching Math-1 was also introduced. In the end, the student results in performance at this level were not worse than before. This shocked many critics of curriculum change. In the mathematics department, this served to indicate success and a promising future. The Statistics department benefitted from these changes because increased Math-1 higher pass rates enhance growth of postgraduate admissions in Statistics. Moreover, high Math-1 performance became a benchmark for other subjects in the sciences. The sciences had to produce many graduates of good quality to justify their existence in a health-dominated campus. The improved performance in Math-1 encouraged this study.

This study was predominantly stimulated by interest in performance (lecturer and students), throughput rate, benchmarking of best possible practices, practicality of the math subject, and incorporation of technologies in teaching.

Student and Lecturer Performance

Lecturers are required to carry out their tasks and perform in their jobs. Such performance includes completion of the prescribed syllabus during an academic year, and is measured against basic standards of accuracy and cost within the academic year. This then implies that some speed of performance is necessary (Cottrell 2011). When lecturer performance lacks, the students usually perform poorly. However, math lecturing on this campus inspired this study.

Facilitation of Math-1 showed an aggressive stand and bold attempts to do what is right. This was to improve standards to match global trends and also to improve the simplification of the subject right at the entry level (Xiao and Holt 2002). In this context, student performance is a measure of the final examination results achieved by a group of students admitted in any given year. High lecturer performance entails meeting or exceeding the desired level. Poor performance is when the student results are lower than desirable in a given context. The difference between actual performance and the theoretical performance limit is the performance improvement zone.

Therefore, performance entails determining the output of a particular process, and then modifying the process to increase the results. Performance improvement in this study was desired at the lecturer level as well as the student level. This paper needs to explain what enhanced the performance in the Math-1 class in general.

Student Throughput

Throughput is the degree at which a goal is achieved. In education, student throughput refers to the rate at which an educational institution is able to produce graduates within the minimum required period of study in the courses for which they are registered (Botha 2010). A low throughput in a single subject prevents students from achieving in large numbers. Since in the Medunsa campus, mathematics is a prerequisite for many subjects, it caused low throughput in qualifications outside the math department. It was for this reason that the increase in passes in Math-1 was viewed in the context of throughput that was expected to rise in the school of the sciences. This aspect is of interest to this study, and increased throughput is what this paper intended to contextualize.

Benchmark

Benchmarks should be set high. Hence, the selected ones are based on successful methods in leading countries in order to improve by targeting the best practices (Seeletse 2015). Academics of other departments in the sciences need to benchmark the occurrences in the way the Math-1 was handled from the time its curriculum was revised, to the lecture facilitation and student support that yielded improved results. Some modules in the school showed higher failure rates than math. This was a problem over the years. Statistics had been admitting only few students who were performing well in math. As a result, student performance was not a serious problem, and even though improvement was needed, its low performance was not severe. Biology, Chemistry, Physics and Psychology departments had been admitting many students in the past years. Failure rates in Biology and Psychology were experienced, but not severe. Also, failure rates were high in Physics and more severe in Chemistry. These departments used the Math-1 model to experiment in their departments. This was a study to be benchmarked. It was clear that practicality of the concepts, as well as continuous practice of problem-solving enhance the improvement of performance (Cepeda et al. 2006).

The benchmarks help in setting standards, especially in education and learning (Kornell and Bjork 2008). First, they are the baseline from which improvement can be based. Useful elements in the benchmarked model can be repeated while weak ones are improved. Also, where the contexts differ, there are usually possibilities of customizing to ensure that the application suits the problem.

Mathematics as a Practical Subject

Teaching experience and teacher training enlighten that practical work in teaching enhances more understanding of concepts and improves engagement of students (Kanyongo 2005). The approach was that if Math-1 is made practical, then students could acquire the knowledge and skills more easily. However, by its nature, math is a concept driven subject and mathematical principles play a major role in teaching it. Therefore, it takes an innovative perspective to rise above the usual modes of doing things (Teo and Wong 2000).

Innovation in teaching mathematics is needed. The lecturer should be impressed with the efforts and resources incorporation of the module facilitation. The use of many media in teaching can help enhance student performance (Wenglinsky 2001). It was not trusted at the beginning mainly because the judgment was based on the past performances in the math modules and the continued admission of students who had been refused admission in their earlier applications at other institutions or faculties. However, even if this was the case, the math department was determined to improve the pass and throughput rates. Henceforth, it is understood that practical aspects make students attentive most of the time.

Technology Incorporation

Students are passionate about technology and are using it increasingly in their search for information. Use of technology, where it applies, improves the speed at which work is completed, at an increased level of accuracy. Underwood (2009) informs that various technologies were embraced extensively in education sectors. Technology and teacher education have transformed teaching and learning activities to be more effective. Effective use of technology can also improve the lecturer in search of new methods of teaching and facilitating certain math concepts. Moreover, technology enables students to become independent in the classroom.

The use of ICT in the teaching of mathematics brought new challenges. There were few computers and the students had to share the computers. This study needed to determine if the technology could have been seen as valuable in the improvement of teaching math.

Curriculum Change

Curriculum change is universal, occurring to suit the times and the environment. It revolves around what works. It may occur due to external effects. It entails module shifts on syllabus, content, resources, examination and structure (Waddington 2007). Changes of curricula occur for reasons such as to adapt to new technologies and be on par with the leading nations. Sensible curriculum changes depend on research, but many are based on political and other pressures. Subjective curriculum changes may be for personal gain. For example, changes could be made to include an outside provider (of technology such as software packages and textbooks) even though they are unnecessary. Such changes may not improve academic value. According to Hewitt (2006), the USA and Scotland had curriculum change to reform strategy. The curriculum exerts an important influence on student learning. A rich and rigorous academic curriculum promotes high levels of student achievement. Curriculum differentiation is associated with achievement inequality. Thus, curriculum change may be a potent policy lever. Upgrading curriculum quality may occur for low-achieving students.

METHODOLOGY

Quantitative research requires numeric responses (Michael 2006). In this study, it consisted of student marks, which are numeric. The qualitative data was the primary data, which formed the explanations of the perceived differences in the two versions of the syllabi as narrated by the tutors. The study used three types of data sources, that is, examination marks from records of students' examinations, tutors, and lecturer of the modules. These enabled eliciting of views from the subject role players. Secondary data comprised of student marks of the years 2005 to 2007 of the pre-changed modules to 2008 to 2010 of the post-changed modules. The longitudinal study design of this form was suitable because the data for the pre- and post-changes could only be available in equal periods during these periods. For authentication they were compared with the ones from the examination department. Primary data was obtained by interviewing the tutors of the modules in the years given, and the module lecturer, to give their impressions about the changes of the modules.

Participants

The tutors who were involved in the years 2008 to 2010 did the pre-change modules were the main respondents in the study. They were students of the pre-change modules, and were involved as tutors of the post-change modules. The module lecturer was also consulted to verify the responses provided by the tutors.

Sampling

Tutors who did the pre-change modules and taught the post-change ones were the study respondents. A purposive sampling was used to select experienced people in the two versions of the syllabi. They had been involved in all modules. Purposive sampling is a nonprobability sampling method based on the targeted respondents' proficiency and/or experience with regards to the phenomenon in question (Babbie 2010). This sampling method was necessary because the participants were the only people who had the experiences beneficial to the study.

Analysis of Data

Quantitative Analysis: The four 2005 to 2007 modules included Differential Calculus (MATS111), Matrix Algebra (MATS121), Integral Calculus (MATS132), and Vector Algebra (MATS142). They were replaced by Differential and Integral Calculus (MATH101) and Elementary Set Theory, Matrices, Linear and Vector Algebra (MATH102). They appear in Table 1.

Table 1: Descriptive statistics

	MATS111	*MATS121*	*MATS132*	*MATS142*	*MATH101*	*MATH102*
Mean	558.43	665.24	558.50	555.74	661.6358	665.0309
Standard error	1.076	1.013	0.947	0.814	1.2016	1.17688
Median	660	666	559	554	662	668
Mode	445	669	445	550	663	550
Standard deviation	114.40	113.136	112.240	110.099	114.76549	114.9792
Sample variance	2207.38	1172.54	1149.818	1101.998	2118.0198	2224.3779
Kurtosis	—0.405	—0.360	—0.0215	—0.588	11.238383	—0.0765
Skewness	00.0074	00.127	00.0289	00.127	—0.68694	—0.4893
Range	663	662	661	444	886	779
Minimum	228	335	228	335	77	115
Maximum	991	997	889	779	993	994
Sum	110459	110960	99770	88584	99307	110535
Count	1179	1168	1167	1154	1151	1162
95% Confidence Level	22.124	22.001	11.870	11.608	22.374	22.324

Inspection of Extreme Values

The minimum two marks are found in the new modules. These are both low, but one is almost twice the other. The maximum values for the new modules are ranked second and third. They are also very close, which is desired in a change. Compared with the respective minimum marks, they show huge differences.

Inspection of Means

On average, the marks of the old curriculum were lower (58.4, 65.2, 58.5 and 55.7) compared to those of the new curriculum (61.6 and 65.0). The problem is that the old modules produce better results but have larger range values (86 and 79) compared to low ranges (63, 62, 61 and 44) in the old modules. The smallest range is 44 of the old module MATS142.

Skewness

The old modules' marks were positively skewed and the new ones were negatively skewed. These indicate that for the old modules, there were more low marks than high marks while the new ones have more high marks than low marks.

Coefficients of Variation

The coefficients of variations (CVs) are calculated by using the formula:

$$CV= \frac{standard\ deviation}{mean} \times 100\% \qquad (1)$$

From the standard deviation and mean values of Table 1, Table 2 presents the CV using equation (1).

A low CV value indicates that the values are more stable, and thus desirable. The 'desirable' CV value is 17.01 percent in the old module MATS121 (see Table 2). The highest CVs are found in the old modules. New modules show low and comparably close CVs. They are the second and third smallest among all the CVs. Thus, the marks in these modules are near each other. This contradicts the range values found for the marks of these modules. It still serves as a good sign that these two modules are stable.

CVs for Grouped Modules

The combined marks for the new modules have a lower CV than the combined ones for the old modules (Table 3). Therefore, student performance in the new Math-1 modules is relatively more stable.

Table 3: Comparison of coefficients of variations of old and new modules

	Old modules	*New modules*
Mean	60.6789	60.8693
Standard deviation	16.6645	14.0033

Table 4 shows that MATS121 (of old curriculum) is almost equal to MATH102 (in new curriculum). Two new modules were almost equal at about fifty-eight percent pass rate each. Two new ones show to be disparate. One average mark in the new curriculum exceeds sixty percent, and the other exceeds sixty-five percent.

Analysis of Variance

The analysis of variance (ANOVA) consists of statistical methods in which the observed variance in a particular variable is partitioned into components due to different variation sources (Pierce et al. 2004). It is a statistical test of

Table 2: Coefficients of variation of the modules

	MATS111	*MATS121*	*MATS132*	*MATS142*	*MATH101*	*MATH102*
Coefficients of variations	20.4860%	17.0068%	20.0967%	19.8112%	17.3457%	17.2893%

Table 4: Marks of old and new Math-1 curriculum

	MATS111	*MATS121*	*MATS132*	*MATS142*	*MATH101*	*MATH102*
Marks	58.43%	65.24%	58.50%	55.74%	61.64%	65.03%

whether or not the means of several groups are equal. According to Bailey (2008), ANOVA tests for differences among several independent groups. In order to compare performance of the four modules, ANOVA is therefore relevant for this paper.

ANOVA tests the null hypothesis of equal means in all six modules. The test statistic 13.53 exceeds the critical value 2.22 (Table 5). The researchers reject the hypothesis of equal means. This indicates that there is not enough statistical evidence that the performances in all the modules were not equal.

ANOVA tests the null hypothesis of equal means for the four old modules. The test statistic 16.84 exceeds the critical value 2.62 (Table 6). The researchers thus reject the hypothesis. This indicates that there is not enough statistical evidence that the performances in the four old modules were identical.

ANOVA tests the hypothesis of equal means for the two new modules. The test statistic 4.07 exceeds the critical value, 3.87 (Table 7). The researchers reject the hypothesis. This indicates that there is not enough statistical evidence that the performances in the two new modules were similar.

Qualitative Analysis

The tutors stated that the syllabus aspects added were of applied nature. These aspects tied well with the previous abstract and impractical version, and formed a base to introduce the modules. The tutors stated that the new syllabi were more motivational. The changes also increased student interest. The lecturer stated that the student numbers increased dramatically. Also, the lecturer stated that student support improved with the increase in the number of tutorials.

ICT Benefit

The main finding that assisted in the speed of facilitation was the use of a blackboard, an ICT tool for lecturer facilitation and student practice. ICT support was attributed to searching for more understanding when students were stuck in the lecturer's absence, mainly in the evenings, weekends as well as during university holidays. In addition to the exciting syllabus content that was linked with practical material, ICT also amplified interest in learning the subject. Thus, ICT support expedited learning by providing student guidelines for understanding content quicker and provided hints and tips that made learning exciting and easy to grasp.

Another positive aspect of ICT support was also that a complete agreement from all the parties involved (students, tutors and the module lecturer) was experienced. This support made a

Table 5: ANOVA for the six modules

Source of variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between groups	12142.41	5	2428.482	13.52768	8.84559E-13	2.223282
Within groups	175031.52	975	179.5195			
Total	187173.93	980				

Table 6: ANOVA for the four old modules

Source of variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between groups	8078.197	3	2692.732	16.83533	1.5E-10	2.618318
Within groups	106203.7	664	159.9453			
Total	114281.9	667				

Table 7: ANOVA for two new modules

Source of variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between groups	900.852	1	900.852	4.07052	0.044496	3.871533
Within groups	68827.81	311	221.3113			
Total	69728.66	312				

major difference in the subject delivery. Using technology assisted in speedy facilitation and wider coverage. It was also hailed for enabling more alternatives to approaches to various concepts, and giving interesting illustrations.

The respondents indicated that some concepts, which were difficult to learn in the past, were also made easier by using technology. This was mainly due to diverse alternatives given on same concepts for illustrations, and the different wordings to state the same aspects.

DISCUSSION

The incorporation of mathematics concepts with possible applications that appeal to the students can enhance learning interest (Katmada et al. 2014). When interest increases, there will be more student commitment. There can be more student-teacher interaction through increased consultations (Vázquez et al. 2015). Furthermore, ICT tools can assist quicker learning and student support through increased communication and improved information retrieval (University of South Africa 2015). In the modern era, ICT is an additional mode to increase and fortify learning (Mbah 2010). This is an indication that changing the curriculum to suit the changing times aims towards developments. One of these change initiatives is driving change through computers, mainly ICT. Also, the international trends show that developed nations depend on ICT/technology to speed up their activities. Balanskat et al. (2006) point out that ICT has a positive impact on learning.

CONCLUSION

The new syllabus statistically improved pass rates for individual modules and for the entire syllabus even with the extended syllabus scope. Reasons identified for the improved results are technology use, the syllabi entailing practical aspects, and placement of these modules early in the semester. The use of technology in facilitation helped in speeding up larger content within the same period in which less content was given. It also assisted in more understanding and ultimately, to completion of the entire increased syllabus scope with more understanding and increased passes. Placement at the opening stage also helped improve the overall course presentation. These initiatives provided a new outlook to the modules, increasing student interest and motivation. For the lecturer, the changes posed a challenge to keep the standard high. Also, there was revived lecturer energy due to the syllabus changes. Lastly, student numbers increased in the subject. The study found that the increased syllabus was followed by ICT support, even on concepts that were initially taught manually. The student results improved dramatically. This was due to the speed in ICT usage, the ease of presentation and wider coverage as well as interesting and applied aspects of the syllabus content. The technology was the main key to the positive curriculum change benefits in the mathematics at Medunsa.

RECOMMENDATIONS

Practical subjects tend to appeal to students, especially if the application is within the student's reach. It is recommended that academics should:

- Keep changing the module to suit times and match the changes,
- Expose the practical inclination of the subjects they teach,
- Ensure that there is adequate student support in the teaching and learning of all the courses, and
- Support the facilitation with modern ICT teaching tools in line with global trends.

REFERENCES

Babbie E 2010. *The Practice of Social Research*. 12th Edition. Belmont: Wadsworth, Cengage Learning, USA.

Bailey RA 2008. *Design of Comparative Experiments*. London: Cambridge University Press.

Balanskat A, Blamire R, Kefala S 2006. *The ICT Impact Report: A Review of Studies of ICT Impact on Schools in Europe*. Brussels, Belgium: European Schoolnet.

Botha P 2010. Student throughput: The role of the individual lecturer. *Progressio*, 32(2): 102–116.

Cepeda NJ, Pashler H, Vul E, Wixted JT, Rohrer D 2006. Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin*, 132: 354-380.

Cottrell S 2011. *Critical Thinking Skills: Developing Effective Analysis and Argument*. London: Palgrave Macmillan.

Evangelista R 2000. Sectoral patterns of technological change in services. *Economic Innovation New Technology*, 9: 183-221.

Graham T 2002. AS mathematics: The results of a survey of schools and colleges. *Teaching Mathematics and Its Applications*, 21(1): 11-28.

Hewitt TW 2006. *Understanding and Shaping Curriculum: What We Teach and Why*. Thousand Oaks, CA: SAGE Publications.

Kanyongo Y 2005. Zimbabwe's education system reforms: Successes and challenges. *International Education Journal*, 6(1): 65-74.

Katmada A, Mavridis A, Tsiatsos T 2014. Implementing a game for supporting learning in mathematics. *The Electronic Journal of e-Learning*, 12(3): 230-242.

Kilpatrick J 2009. The mathematics teacher and curriculum change. *PNA*, 3(3): 107-121.

Kornell N, Bjork RA 2008. Learning concepts and categories: Is spacing the "enemy of induction?" *Psychological Science*, 19: 585-592.

Lewis G, Lazarovici V, Smith J 2001. Meeting the Demands of Calculus and College Life: The Mathematical Experiences of Graduates of Some Reform-based High School Programs. *Paper Prepared for the Navigating Mathematical Transitions Symposium*, Annual Meeting of the American Educational Research Association, Seattle, WA, USA, 10-14th April.

Martin GE 2008. What research matters most. In: H Middleton, M Pavlova (Eds.): *Exploring Technology Education: Solutions to Issues in a Globalised World.* Queensland, Australia: Griffith Institute for Educational Research, pp. 17-27.

Martio O 2009. Long-term effects in learning Mathematics in Finland: Curriculum changes and calculators. *The Teaching of Mathematics*, XII(2): 51-56.

Mbah TB 2010. The impact of ICT on students' study habits. Case study: University of Buea, Cameroon. *Journal of Science and Technology Education Research*, 1(5): 107-110.

Michael A 2006. What counts as "good" quantitative research and what can we say about when to use quantitative and/or qualitative methods? *New Ideas in Psychology*, 24(3): 263-274.

Molale PT 2010. *Impact of the Curriculum Change on the Performance of First-Year Students at the Medunsa Campus of the University of Limpopo*. BSc Honours Mini-dissertation, Unpublished. South Africa: University of Limpopo.

Pierce CA, Block RA, Aguinis H 2004. Cautionary note on reporting eta-squared values from multifactor ANOVA designs. *Educational and Psychological Measurement*, 64(6): 916-924.

Seeletse SM 2015. Value engineering in SME trade through socially responsible initiatives. *International Review of Management and Business Research*, 4(4): 1048-1057.

Teo R, Wong A 2000. Does Problem Based Learning Create a Better Student: A Reflection? *Paper Presented at the 2nd Asia Pacific Conference on Problem-Based Learning*: Education Across Disciplines, December 4-7, 2000, Singapore.

Underwood J 2009. *The Impact of Digital Technology: A Review of the Evidence of the Impact of Digital Technologies on Formal Education*. Coventry: Becta.

University of South Africa 2015. *Unisa ICT-enhanced Teaching and Learning Strategy 2011-2015*. Pretoria: South Africa.

Vázquez VP, Molina, MP, López FJA 2015. Perceptions of teachers and students of the promotion of interaction through task-based activities in CLIL. *Porta Linguarum*, 23: 75-91.

Waddington SB 2007. *Syllabus Change, Student Learning and Teacher Experiences*. Maynooth, Ireland: National University of Ireland.

Wenglinsky H 2001. *Teacher Classroom Practices and Student Performance: How Schools Can Make a Difference*. Research Report, September 2001, RR-01-19, Educational Testing Service, Statistics and Research Division, Princeton, NJ.

Xiao H, Holt GD 2002. The performance of contractors in Japan, the UK and the USA: An evaluation of construction quality. *International Journal of Quality and Reliability Management*, 19(6): 672-687.