

A Comparison of Mathematics Curriculum Documents of GCE O Level and SSC Systems

Haleema Bano* and Muhammad Saeed Khan**

The purpose of conducting this research was to compare mathematics curriculum documents of two different systems for secondary education namely SSC (Secondary School Certificate) and O Level. The objectives were: to compare the mathematics curriculum at GCE (General Certificate of Education) O Level and secondary school certificate system with special reference to; objectives, content and teaching method; and to find out comparative strengths and weaknesses in curriculum objectives, content and teaching methods suggested for teaching mathematics both in the GCE O Level system and SSC system. Research method included survey technique and documentary analysis. The curriculum documents of both the systems were analyzed to collect data about objectives of mathematics teaching, the content offered and methods of teaching as recommended by the document. Text-books were analyzed by the teachers with the help of an evaluation scale. Data analysis involved Mann Whitney U test, t test and documentary analysis. Results showed that O Level system of secondary education has more comprehensive objectives for mathematics teaching and better text-books. The methods of teaching suggested in both the documents however, were found same. It was recommended to revise objectives, set for mathematics teaching and the text-books taught in SSC system of secondary education.

Keywords: GCE O level, Curriculum objectives, SSC system

This article can be cited as:

Bano, H. & K, M.S. (2015). A comparison of Mathematics Curriculum Documents of GCE O Level and SSC Systems. *Journal of Arts and Social Sciences*, 2(2), 66-80.

* HaleemaBano, M.Phil (Education) Scholar Lecturer, Department of Education, University of Haripur, Khyber Pakhtunkhwa

** Muhammad Saeed Khan (Corresponding Author) Head Department of Education, University of Haripur, Khyber Pakhtunkhwa Office: 0995-615399 Cell: 03008303638, Email: saeedagha03@gmail.com

Mathematics is significant not only for school accomplishments but also for producing well versed civilians, selecting productive occupation and satisfying ones individual needs. Mathematics provides basis for success in various subjects throughout the educational career of the learner. Across the world, mathematics enjoys a pivotal place among all the school subjects. With the expansion of public education in general and secondary school education in particular, it is highly desirable to equip the learners with skills of precise calculation, ability of correct estimation and accurate application of mathematical knowledge. Mathematics education affects the today's societies strongly but invisibly (Davis & Hersh, 1986; Skovsmose, 2006).

Secondary education in Pakistan is offered in two parallel qualifications namely Secondary School Certificate in public sector and Ordinary Level in private sector. Naeemullah (2002) pointed out that existence of parallel systems of education in Pakistan is a serious matter of concern for the government of Pakistan who thrives to gain the standard of equity. Quality of mathematics teaching in Pakistan is influenced due to the fact that evaluation in SSC system is entirely text-book based. Thus a text-book stuffed with information is considered as an end in itself instead of a tool for achieving targets and memorization of that text-book is considered enough to attempt stereotyped test. Asma (2008) points out that conceptual learning in mathematics is lacking in Pakistani schools where text-books contain only a brief introduction of the concepts followed by a long list of questions related to that concept. Solving those sums to obtain correct answers, then becomes the sole aim of students as well as of teachers. The National Council of Educational Research and Training (2006) has identified poorly designed curriculum which cannot cater the individual differences found in the class, as one of the important reason for low academic achievement in mathematics.

Objectives Of Teaching Mathematics

Objectives are designed by expert professionals with due care to ensure the achievement of desired goal. Educational objectives are set to make the entire teaching learning process meaningful. National Education Policy (2009) acknowledges the role of mathematics education while describing the general objectives of education. It is stated that education aims to produce self-dependent individuals who can think critically and creatively, act as responsible member of a society and citizens of global community and mathematics teaching inculcates these attributes in the pupils. A more generally accepted purpose of mathematics education is to mathematize thoughts of students (NCERT, 2006). According to Wheeler (1982) mathematician of intellect must be preferred to learning a lot of mathematics. It can be inferred that conceptual learning is preferred over accumulation of mathematical knowledge

Methods Of Teaching Mathematics

It has been found through various researches that mathematics classroom is characterized by the dominance of the teacher, who verbally communicates the content. He never bothers to help students learn higher order thinking skills and make use of learnt content in real life circumstances (Beard & Wilson, 2005). It is suggested to use investigation as teaching strategy in mathematics classroom (NCTM, 2003). Students, who learn through activity and engagement, can better examine and discover relationships, find solutions to problems, and provide evidence (Robertson, 2005). Problem solving approach in mathematics is based on cooperative learning. Cooperative learning is characterized by genuine mental engagement, arguing, working collectively, sharing outcomes and challenging viewpoints. Felder and Brent (2001) claim that researches have established this fact that long lasting learning takes place when students are actively involved in this procedure. Problem based learning equips the learner with the ability to find a proper, suitable solution of a problem she/he faces (Hmelo-silver, 2004). In a problem based learning session, a deliberate, organized, and meaningful struggling is done so that a conclusion, a way out may be found for an issue, a problem of educational worth and value (Achike & Nain, 2005). McConnell (2005) asserts that students are involved in intricate problems and they have to think critically for finding a way out and to promote higher order thinking skills in students in order to encounter a genuine problematic situation. There is a growing trend to adopt this technique for teaching purposes (Savin-Baden & Wilkie, 2004).

Enquiry based learning is a sequence of steps starting with open-ended questions, examining various facts, collection and comprehension of data to build up new knowledge, arguing and reasoning about new learning. This technique is more often used for mathematics teaching (Bissell & Lemons, 2006). In this method questions are posed to students, they encounter a problem and have to find logical justification for certain observation (Dochy, Segers, Bossche & Gijbels 2003).

Curriculum provides us with focus and structured plan of action to meet the desired objectives. It delineates the entire sphere of subject matter. Shardlow (2007) asserts that a thoroughly planned manuscript of a curriculum provides us with a structured plan of work promote and enhance our intellect, can help implement better, and refine the teaching method. Educationist attaché immense value to the concept of curriculum for educators, as this is exactly what they have to target, teach, handle and achieve through entire practice of schooling. The modern math curricula are based on constructivist approach which asserts that learners

must be facilitated in making use of their personal experiences for developing a perception of mathematical environment.

Content

A text-book is text developed exclusively for achieving the objectives set by the curriculum document of a specific discipline. It intends to provide content in this regard. The significance of textbook is acknowledged widely due to its pivotal role in making curricular expectations a reality. Textbook as a source of knowledge has a central place in classroom teaching. Authors of textbook have a huge responsibility of anticipating and understanding the minds of the learners. They need to plan and arrange the subject matter with extreme care. It must be involving and striking. The authors should be highly educated and eminent expert of their field (Govt. of Pakistan, 2006). Polaki (2006) points out the gap between textbook and mathematics syllabus. The content of the textbook is based on technical and computational aspect, whereas, mathematics syllabus demands the enhancement of higher order thinking skills. In Pakistan, not only this textbook is the single source of teaching learning but the SSC board paper is also based on this textbook (Christie & Afzaal, 2005). Khushk and Christie (2004) assert that one of the reasons for poor quality of education in Pakistan is heavy reliance on a single textbook.

Significance

It is expected that outcomes of the study will bring into light the strength and weaknesses in mathematics content offered both in GCE O Level system and SSC system. Curriculum planners and experts may benefit from the findings in making decisions for content selection. Secondary school students of both GCE O Level system and Secondary school certificate system may ultimately benefit from the findings of the study.

Research Objectives

The objectives of the study were to compare the mathematics curriculum at GCE O Level and Secondary School Certificate system with special reference to:

1. Objectives
2. Content
3. Teaching methods (suggested)

Research Questions

1. To what extent the objectives of teaching mathematics specified in curriculum are same or different, both in GCE O Level system and SSC system?
2. To what extent the mathematics content offered is same or different both in GCE O Level system and SSC system, in terms of quality and quantity?
3. To what extent teaching methods for mathematics specified in curriculum are same or different both in the GCE O Level system and SSC system?
4. What are the comparative strengths and weaknesses in objectives, content and teaching methods suggested for teaching mathematics both in the GCE O Level system and SSC system?

Method

The researcher used descriptive research method. Survey method of data collection which is commonly used in descriptive research, was used along with documentary analysis.

Population

The curriculum documents with text books of GCE O level and SSC level and all the teachers teaching mathematics in the public and private sector secondary schools of Islamabad constituted population of the study

Sample And Sampling Technique

Curriculum documents of GCE O Level system (Cambridge O Level Mathematics Syllabus D 2009, University of Cambridge, Cambridge, UK) and SSC system National Curriculum for Mathematics 2006 developed by Curriculum Wing, Federal Ministry of Education, Islamabad, Pakistan were taken as sample. Textbook for SSC students published by Khyber Pakhtunkhwa Textbook Board, Peshawar, and O-Level textbooks published by Oxford University Press, Karachi, Pakistan were taken as sample. For this purpose ten schools from each sector were selected through simple random sampling. Of these sample schools twenty mathematics teachers, ten from public schools and ten from private schools (one mathematics teacher from each school) participated in the study.

Instrumentation

The objectives written and methods of teaching suggested in curriculum documents of GCE O Level system and SSC system were compared using documentary analysis. Whereas

content given in textbooks of GCE O Level system and SSC system was analyzed by teachers of both the systems using a four point rating scale. An online (available at <http://mc2.nmsu.edu/mathstar/texts/texteval.pdf>) textbook evaluation rating scale was adapted to seek the opinion of teachers about the quality of textbooks they were teaching in SSC system or O Level system. Both the textbooks were evaluated using following aspects: creates a deeper understanding of content (7 items); supports equity through a student-centered approach to learning (9 items); utilizes authentic assessment (4 items); incorporates technology (calculators, computers, etc.) into student learning (4 items); and provides sufficient support for teachers (6 items). Teachers were asked to rate each item for the above aspects of their respective textbooks:

0 = this element is not evident in the textbook being evaluated

1 = some evidence of this element is in the textbook being evaluated

2 = this element is a component of the textbook being evaluated

3 = this element is very evident in the textbook being evaluated

Data Collection

Data about objectives and methods suggested for teaching mathematics were collected from curriculum documents of GCE O Level system and SSC system by documentary analysis. Data about contents were collected through opinions of twenty teachers, ten from each sample government school who were using textbook for teaching SSC students published by Khyber Pakhtunkhwa Textbook Board, Peshawar, and other from ten O-Level system school teachers who were using O-Level textbooks published by Oxford University Press, Karachi, Pakistan. The researcher visited the sample schools to get the rating scale filled by teachers.

Data Analysis

An analysis of curriculum documents was done qualitatively by thoroughly examining objectives and teaching methods suggested in both the documents, comparing and contrasting them for figuring out their common and uncommon areas whereas text-book evaluation was done quantitatively. Teachers' rating were tabulated and Mann-Whitney was applied to compare the opinion of teachers about the quality of text book taught both in SSC system and O Level system.

Analysis of Objectives of Teaching Mathematics

National Curriculum for Mathematics (2006) SSC System

The document of National Curriculum for Mathematics (2006) SSC System developed by Curriculum Wing, Federal Ministry of Education, Islamabad, Pakistan was analyzed using document analysis technique. This curriculum document identifies following objectives of teaching mathematics:

1. It aims to lay a sound base for learning mathematics with clarity of mathematical concepts. It is expected that learner will enhance his learning and be able to apply it effectively.
2. It puts stress on the concepts of geometry which facilitates logical thinking, organized reasoning and finding relationships wisely.
3. Graphical representations are incorporated to facilitate imagination and accurate explanation of concepts instead of handling them abstractly.
4. It acknowledges the positive role of recent technology in improving the quality of math's teaching.
5. This curriculum assigns to a teacher, the role of a guide, a facilitator and a supervisor rather than an authority in knowledge and ultimate source of information. In addition to the text-books, teachers' manual workbook and electronic means are also mentioned to provide support for mathematics teaching and learning.

Curriculum Document of GCE O Level system

The curriculum document of GCE O Level system (Cambridge O Level Mathematics Syllabus D 2009, University of Cambridge, Cambridge, UK) identifies following objectives for teaching mathematics.

1. To enhance scholarly inquisitiveness, to enable them to express and convey mathematically, to examine and probe into methods of analyzing facts.
2. To impart knowledge about basic mathematical concepts of numbers, measures and space and also develop an ability of making use of this knowledge in real life circumstances.
3. To provide learners with a sound and solid base of mathematical knowledge and skills which are related to other subject areas.
4. To enable learners to admire the inherent beauty of this discipline and draw from pleasure, gratification and self-reliance by getting hold of this discipline and its related skills.

Analysis of Content and its Interpretation

A textbook evaluation scale (four point) was used to obtain data about content offered in both SSC and O Level systems. This scale consisted of thirty items (statements) about quality of content of the textbook. These statement were asked about five different aspects of textbook namely creating deeper understanding on content, supporting equity through a student centered approach to learning, utilizing authentic assessment, incorporating technology into students learning and providing sufficient support to teachers. For table one score of all thirty statements were taken to compute mean score for opinion of the teachers.

Table 1: Comparison of the opinion of SSC and O level teachers about the entire text-book taught at SSC and O level

| Teacher | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Z | sig |
|---------|----|-----------|--------------|----------------|--------|-------|
| SSC | 10 | 8.20 | 82.00 | 27.00 | -1.741 | 0.089 |
| O level | 10 | 12.80 | 128.00 | | | |

Table 1 shows that the mean rank of SSC teachers (8.20) is less than O level teachers (12.80) about the text book taught at SSC and O level but Mann-Whitney U test shows that the calculated value of z (-1.741) is not significant at 0.05 level. It can therefore, be concluded that there is no difference between the opinions of SSC and O level teachers about the text-book taught at SSC and O level.

Table 2: Comparison of the opinion of SSC and O level teachers about the component of creating deeper understanding on content, of the text book taught at SSC and O level

| Teacher | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Z | sig |
|---------|----|-----------|--------------|----------------|--------|-------|
| SSC | 10 | 8.05 | 80.50 | 25.500 | -1.886 | 0.063 |
| O level | 10 | 12.95 | 129.50 | | | |

Component of creating deeper understanding of content of the textbook was analyzed with the help of seven statements given in the first category of rating scale for example “Builds conceptual understanding through a logical sequence of related mathematical ideas” and “Provides students with opportunities to explore open-ended problems that have multiple solutions”.

Table 2 shows that the mean rank of SSC teachers (8.05) is less than O level teachers (12.94) about the component of creating deeper understanding on content, of the text book taught at SSC and O level but Mann-Whitney U test shows that the calculated value of z (-1.886) is not significant at 0.05 level. It can therefore, be concluded that there is no difference between the opinions of SSC and O level teachers about the component of creating deeper understanding on content, of the text book taught at SSC and O level.

Table 3: Comparison of the opinion of SSC and O level teachers about the component of supporting equity through a student centered approach to learning, of the text book taught at SSC and O level

| Teacher | N | Mean Rank | Sum of Ranks | Mann-Whitney U | Z | sig |
|---------|----|-----------|--------------|----------------|--------|-------|
| SSC | 10 | 9.65 | 96.50 | 41.500 | -0.647 | 0.529 |
| O level | 10 | 11.35 | 113.50 | | | |

Component of supporting equity through a student-centered approach to learning was analyzed by asking nine statements in the second category of rating scale for example “Provides all students with equal opportunities to engage in worthwhile mathematical tasks” and “Free from cultural, ethnic, and gender bias”.

Table 3 shows that the mean rank of SSC teachers (9.65) is less than O level teachers (11.35) about the component of supporting equity through a student centered approach to learning, of the text book taught at SSC and O level but Mann-Whitney U test shows that the calculated value of z (-0.647) is not significant at 0.05 level. It can therefore, be concluded that there is no difference between the opinions of SSC and O level teachers about the component of supporting equity through a student centered approach to learning, of the text book taught at SSC and O level.

Table 4: Comparison of the opinion of SSC and O level teachers about the component of utilizing authentic assessment, of the text book taught at SSC and O level

| Teacher | N | Mean Rank | Sum of Ranks | Mann-Whitney U | z | sig |
|---------|----|-----------|--------------|----------------|--------|-------|
| SSC | 10 | 6.45 | 64.50 | 9.500 | -3.092 | 0.001 |
| O level | 10 | 14.55 | 145.50 | | | |

Component of utilizing authentic assessment was analyzed by asking four statements in the third category of rating scale for example “Embeds continuous assessment in student learning” and “Uses multiple forms of assessment (e.g. projects, portfolios, reflections, journals, free-response tests)”

Table 4 shows that the mean rank of SSC teachers (6.45) is less than O level teachers (14.55) about the component of utilizing authentic assessment, of the text book taught at SSC and O level but Mann-Whitney U test shows that calculated value of z (-3.092) is significant at 0.05 level. It can therefore, be concluded that there is significant difference between the opinions of SSC and O level teachers about the component of utilizing authentic assessment, of the text book taught at SSC and O level with O level teachers identifying high degree of presence of this element in O level text book.

Table 5: Comparison of the opinion of SSC and O level teachers about the component of incorporating technology into students learning, of the text book taught at SSC and O level

| Teacher | N | Mean Rank | Sum of Ranks | Mann-Whitney U | z | sig |
|---------|----|-----------|--------------|----------------|--------|-------|
| SSC | 10 | 8.15 | 81.50 | 26.500 | -1.798 | 0.075 |
| O level | 10 | 12.85 | 128.50 | | | |

Component of incorporating technology into students learning was analyzed by asking four statements in the fourth category of rating scale for example “Uses technology frequently to allow students to discover and investigate mathematical ideas” and “Reflects the use of technology in real-life applications and careers”.

Table 5 shows that the mean rank of SSC teachers (8.15) is less than O level teachers (12.85) about the component of incorporating technology into students learning, of the text book taught at SSC and O level but Mann-Whitney U test shows that the calculated value of z (-1.798) is not significant at 0.05 level. It can therefore, be concluded that there is no difference between the opinions of SSC and O level teachers about the component of incorporating technology into students learning, of the text book taught at SSC and O level.

Table 6: Comparison of the opinion of SSC and O level teachers about the component of providing sufficient support to teachers, of the text book taught at SSC and O level

| Teacher | N | Mean Rank | Sum of Ranks | Mann-Whitney U | z | sig |
|---------|----|-----------|--------------|----------------|--------|-------|
| SSC | 10 | 9.75 | 97.50 | 42.500 | -0.570 | 0.579 |
| O level | 10 | 11.25 | 112.50 | | | |

Component of providing sufficient support for teachers was analyzed by asking six statements in the fifth category of the rating scale for example “Provides content background information for teachers” and “Provides both intervention and enrichment activities”.

Table 6 shows that the mean rank of SSC teachers (9.75) is less than O level teachers (11.25) about the component of providing sufficient support to teachers, of the text book taught at SSC and O level but Mann-Whitney U test shows that the calculated value of z (-0.570) is not significant at 0.05 level. It can therefore, be concluded that there is no difference between the opinions of SSC and O level teachers about the component of providing sufficient support to teachers, of the text book taught at SSC and O level

Results

Comparison of aims of teaching mathematics at SSC and O level

1. The inculcation of conceptual mathematical knowledge and ability to make an effective application of that learning are same in both the documents.
2. The O Level curriculum document, however, includes enhancing inquisitiveness among students and enabling them to admire the inherent beauty of this discipline as its objectives. It aims to introduce to the learner the element of joy success and pleasure associated with the discovery of concepts in this subject. Such an element is not evident in the aims of curriculum document of SSC.

Comparison of Content and its Interpretation

| Component of textbook analyzed | Difference in opinion of teachers of SSC system and GCE O Level system |
|---|--|
| Creating deeper understanding on content | No difference |
| Supporting equity through a student centered approach to learning | No difference |
| Utilizing authentic assessment | Significant difference |
| Incorporating technology into students learning | No difference |
| Providing sufficient support to teachers | No difference |
| Overall text book | No difference |

Discussion

This study was conducted to make a comparison of mathematics curriculum in SSC system and O Level system of secondary education. This analysis revealed that the element of conceptual learning and application of that learning are the similar objectives in both the

documents however, promoting learners inquisitiveness and appreciation for the inherent beauty of this discipline as objectives are only found in the curriculum document of O Level system. Mathematic curriculum (2006) of SSC system was also found lacking mathematical notations, instructions regarding use of technology, progression and grading and reporting policy. According to the teachers rating of the text-books, the only dissimilarity found was in possessing the component of utilizing authentic assessment. This element was more evident in the text-books of O Level system. The methods of teaching recommended in curriculum was found similar in both the documents which were enquiry method and problem solving method.

It was found that objectives for teaching mathematics are more comprehensive in curriculum document of GCE O level as they involve developing higher order thinking. An evidence is the enhancing scholarly inquisitiveness and enabling students to admire inherent beauty of this discipline as objectives of mathematics teaching are part of mathematics curriculum of GCE O Level whereas mathematics curriculum document of SSC aims to inculcate logical thinking through graphical representation. The content offered in the curriculum document of GCE O Level includes fewer concepts but in greater depth and details but the content offered in the curriculum document of SSC level includes too many concepts but with insufficient depth and details. Shardlow(2007) asserts that a thoroughly planned manuscript of a curriculum provides us with a structured plan of work promote and enhance our intellect, can help implement better and refined teaching method. On the contrary Asma (2008) comes up with findings that mathematics text-books in Pakistan contain only a brief introduction of the concepts followed by a long list of questions related to that concept. The component of utilizing authentic assessment is better utilized in the text-books of O Level. The research findings about the text-books are aligned with findings of Ashfaq (2008) which points out the good quality curriculum and very well illustrated elaborated and printed text-books in O Level system.

Recommendations

The component of promoting inquisitiveness of learners and appreciation of the aesthetic element of this discipline by them can be incorporated in the objectives of teaching mathematics formulated in the curriculum document of SSC system.

The text-books taught in SSC system can be revised to incorporate in it the element of authentic assessment.

Teachers of both the systems can be introduced to the text books of each other with the

purpose to examine them and can be asked to cross evaluate each other's text-books.

A detailed documentary analysis of the text-books taught in both the systems can be carried out to compare the quantity of the content offered, the way it is presented, the horizontal and vertical distribution of various concepts and alignment of the content with the objectives set by the curriculum document.

References

- Achike, F.I. & Nain, N. (2005). Promoting problem-based learning in nursing education: A Malaysian experience. *Nurse Education in Practice*, 5(5):302-311
- Asma, A. S. (2008). A stochastic Paris-Erdogan model for fatigue crack growth using two state model, *Bull. Malays. Math. Sci. Soc.* 31(1): 97-108.
- Ashfaq, U. (2008). A study on social acceptability of O and A level of education system and its implication in Pakistan. University Institute of Education and Research, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.
- Beard, C. & Wilson, J. P. (2005). Ingredients for effective experiential learning: the learning combination lock. In Hartley, P & Berzonsky, K (Eds.) *Enhancing teaching in higher education: New approaches for improving student learning*. York: Routledge/Higher Education Academy, 3-15.
- Bissell, A.N. & Lemons, P.P. (2006). A new method for assessing critical thinking in the classroom. *Bio-science*, 56(1):66-72.
- Christie, T. & Afzal, M. (2005). Rote memorization as a sufficient explanation of secondary school examination achievement in Pakistan: an empirical investigation of a widespread assumption paper presented at IAEA Conference in Abuja, Nigeria. Retrieved on May 15, 2012 from www.aku.edu/akueb/IAEA05.pdf
- Davis, P. J., & Hersh, R. (1986). *Descartes dream*. Brighton, England: Harvester
- Dochy, F., Segers, M., Bossche, P. & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning & Instruction*, 13, 533-568.
- Felder, R. M. & Brent, R. (2001). Effective strategies for cooperative learning. *Journal of Cooperation and Collaboration in College Teaching*, 10(2):69-78. Retrieved on May 15, 2012 from [http://www.ncsu.edu/felder-public/Papers/CLStrategies\(JCCCT\).pdf](http://www.ncsu.edu/felder-public/Papers/CLStrategies(JCCCT).pdf)
- Govt. of Pakistan, (2006). National Curriculum for Mathematics Grades I-XII. Curriculum Wing, Ministry of Education, Islamabad.
- Govt. of Pakistan, (2009). National Education Policy. Ministry of Education, Islamabad.
- Greer, B. (2008). What is mathematics education for? Portland State University, Portland, U.S.A.

- Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3):235-266.
- Khushk, A. S. & Christie, T. (2004). Perceived consequences of syllabus innovation in the Pakistan secondary school certificate examination. Paper presented at third ACEAB conference. Nadi, Fiji.
- McConnell, J.J. (2005). Active and cooperative learning. *ACMSIGCSE Bulletin*, 34(4):34-38.
- Naeemullah, M. (2007). Comparative study of curriculum, teaching methodology and examination system of GCE (A-Level) and F.Sc. level in basic sciences. (Unpublished) Ph.D. Thesis University of Arid Agriculture Rawalpindi Pakistan.
- National Council of Educational Research and Training, (2006). National Focus Group on Teaching of Mathematics. New Delhi, India.
- National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.
- NCTM, (2003). *Principles and standards for school mathematics*. The national council of teachers of mathematics, Inc.
- Polaki, M.V. (2006). Looking at the mathematics curriculum and mathematics textbooks to identify statistical concepts that Lesotho's high school students experience. ICOTS-7, National University of Lesotho.
- Robertson, D.R. (2005). Generative paradox in learner-centred college teaching. *Innovation in Higher Education*, 29(3):181-194.
- Savin-Baden, M., & Wilkie, K. (2004). Challenging research in problem-based learning.
- Shardlow, M. L. (2007). Curriculum: theory and practice in mathematics. 3rd ACEL-Microsoft online conference on innovative teaching and learning. Methodist Ladies College Kew, Victoria, Australia
- Skovsmose, O. (2006). *Traveling through education: Uncertainty mathematics, responsibility*. Rotterdam: Sense Publishers
- University of Cambridge (2009). Cambridge O Level Mathematics (Syllabus D). Syllabus code 4024. For examination in June and November 2012
- Wheeler, D. (1982). Mathematization matters. For the *Learning of Mathematics*, 3(1): 45-47

