

Curriculum of Mathematics in Pakistan and International Standards: A Comparative Study

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Abstract

Curriculum which is considered as the main tool education cannot remain the same endlessly. With the expansion of spectrum of knowledge, upgrading of the curriculum is needed with the passage of time. It is nevertheless, the timely updates and restructuring of curriculum can enhance the standard of education. It is therefore, change in curriculum and comparative analysis of the curriculum has been a hot debated topic not only in Pakistan but also all around the world. Current design of the study can be used to analyze the curriculum of mathematics for secondary level of education prescribed by the Punjab Text Book Board. The sole purpose of this comparative study of mathematics is to better analyze the policy objectives of the subject of mathematics curriculum for education at secondary level in Pakistan. Secondly, the study was aiming to analyze curriculum processes while referring to certain objectives, content, methodology and assessment techniques. Thirdly, this research study was aiming to critically review the subject matter of mathematics while highlighting the strengths and weaknesses of the subject of mathematics taught at secondary level of education in Pakistan. Fourth, the aim of this research study is to explore the suggestions of curriculum specialists about the salability of the value of mathematics curriculum in education of secondary level in Pakistan. Suggestions and recommendations are provided in the end of the research study while better concluding the results and findings in the end of the paper.

Key Words:

Secondary Education Commission, Algebra, Concomitant Curriculum, Manipulation

Introduction

The quality of an overall system of education depends upon the quality of education provided at secondary level. It is because of the fact the stage believing to “make or break” the educational career of a student (World Bank, 2013) and

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the most significant subjects till the secondary grades of education is mathematics (Sullivan, P., 2011). It is because of the fact this subject enables students to acquire exceptional outcomes in their academic career (Bruhlmeier, 2010). The value of the subject of mathematics has been recognized by various authorities at various times. Historically in this area, a number of organized efforts have been determined in context to promoting the education of mathematics. The most prominent among them are: Zakir Hussain Committee in the subcontinent during 1937, the Secondary Education Commission India in 1952 and Kothari Commission India in 1964 all have been seen active in the promotion of education of mathematics at school level (Sharan & Sharama, 2008). The main focus has been given on the subject of mathematics for education in secondary schools in Asian countries especially in region of East Asia (Tu, R., & Shen, W., 2010). The result of this intense intention towards teaching mathematics at secondary level is apparent from the outcome of successive international studies held during the previous twenty years (TIMSS, 2011). Moreover, the other reason of this high attention towards teaching of mathematics is the upward movement in the economic growth of countries of this region in the first decade of current century (ISR, 2011). In Pakistan two system of education of equal are running simultaneously. For instance GCE (the General Certificate of Education) which is a UK based system of education and recognized internationally which is equal to SSC (secondary school certificate) of Pakistan. The existence of GCE system of education has been reported since 1959 and a huge number of educational institutions are providing this education all around the country.

The research studies undertaken in Pakistan till now are revealing the fact that in our local SSC system of education teaching of mathematics is not provided up to the mark as it is provided in a traditional style of lectures while eliminating the most important content of procedural knowledge from the lecture (Akhtar, M. and Ahmad Saeed, A., 2014). Unlike Pakistan in countries like China, Singapore and Japan a significant intention has been paid to procedures of doing mathematic i.e. problem solving style of learning in addition to using intrinsic and extrinsic means to motivate the students to learn the knowledge of mathematics (Zhang et.al., 2004). It is because of the fact that a special attention has been given on teaching mathematics in these countries. This dissertation is based on the comparative study of the syllabus of mathematics in Pakistan at secondary level of education and it will enable to communicate the pros and cons of the existing system of teaching mathematics in the country. There have been found a large number of comparative studies advocating different subjects and various areas of teaching and learning skill across the globe. Similarly, in Pakistan a major work on comparative studies has been done in different subject but little work has been done on the subject of mathematics and specifically to

compare the syllabus of mathematics at secondary level of education in Pakistan i.e. GCE & SSC.

Curriculum

The word curriculum comes from the Latin word meaning “race course” while the meanings of the word race & course are time and path correspondingly. It is therefore described the curriculum as the agreed path of study which is to be covered in a given period of time. Curriculum is considered as a field of study and the evolution of the subject began in 1890 with the publication of first book on curriculum titled as “The Curriculum” in 1918 by publishers i.e. Franklin Bobbitt (Govt. of Pakistan, 2006). The main objective of the curriculum development is to develop knowledge, skills and such habits of mind among the students enabling them to live a successful life while returning a lot to the society.

It is nevertheless understood phenomena that increase in the use of technology will increase the value of mathematical skills and knowledge. It is because of the fact a well-organized curriculum of mathematics involving certain procedures and process helps students to enhance their reasoning, justification and skills of expressing their ideas clearly (Samo, Students’ perceptions about the symbols, letters and signs in algebra and how do these affect their learning of algebra: A case study in a government girls’ secondary school, Karachi., 2009). A well-structured framework of curriculum helps the students at secondary level in the identification of relationship between concepts of math and their routine life while connecting the mathematical concepts with different situations while living in the world.

Syllabus

The word syllabus is a derivation of Latin word “syllabus” list which is similar to the Greek word meant as “parchment label, table of contents”. In Latin the word the word syllabi which have been mistakenly known as syllable. The aim of the syllabus is to establish impartial understanding between the teachers and the students such as confusions in terms of policies established for the development of course framework while setting standards for the accurate learning of the material and development of behavior in the class room. The other objective of the syllabus is to provide a roadmap or a framework for the instructors while teaching philosophy of the subject to the students and making the subject material attractive for the learners. In the development of syllabus different items required to be augmented in a particular curriculum for the sole purpose of maximizing attainment of effective learning skills like grading policy, grading rubric, late work policy, locations and times. Hence, a syllabus must comprise of the reading lists of books and articles which are necessary for the students to

learn. It is the syllabus that can enable scholars to understand the academic impact of their work on the subject matter (Suurkamm and Veizan, 2010).

Different Types of Curriculum

Curriculum is a planned activity tends to facilitate learning through a devised method of teaching (Holsinger, 2000). It is an understood phenomenon that human beings have been the right of the getting education and enhancing their basic skills including combination of hidden skills, null, written, political, social and logical. Hence to impart quality education to students at secondary level it is therefore schools use different types of curriculum.

Written, Overt and Explicit Curriculum

Explicit curriculum is composed of the components found in written format which is properly designed and reviewed by the administrators and directors responsible of the formulation of curriculum and the teachers whom are the direct participants of the process. Curriculum relating to experience is somewhat related to the overall experience of an individual attained during the school education.

Social Curriculum

Social curriculum is a continuous and informal framework of the course adopted similarly adopted by peer groups and different school. It is further equipped with the use of social media which can help in the development of emerging perspectives in addition to shaping the opinion of students as well as the public.

Covert Curriculum

This type of curriculum used in educational institutions in order to teaching students in a hidden form i.e. education given from the nature and organizational designs of the school in addition to teaching through behavior and attitude of the teachers and the administrators. However, this form of curriculum is having dual aspects such as negative and positive. However, the strength of this sort of curriculum is highly dependent on the given models and perception of the students (Rizvi & Elliot, 2005).

The Null Curriculum

In this form of curriculum the educational institutions are proposed not only to focus on the participation of essential elements of teaching but also inclusion of neglected things in their academic courses. It also includes material which may be neglected by the students or the material that have not been involved in the

procedures or incapable of achieving consequences in their future lives (Strogatz, et.al., 2009).

Phantom Curriculum

This type of curriculum is used when it is required to spread the message while using different forms of media. In such form of curriculum a significant role is played by the messages and components used by the educational institutions while inculcating students in the predominant meta- culture in addition to acculturating students into narrower and generational subculture.

Concomitant Curriculum

This type of curriculum is often adopted in religious spots aiming to train students religiously, providing them training on values, ethics, morals and modeled behaviors. This sort of curriculum may also be composed of elements preferring the experiences of the family while growing up an individual in a good manner.

Rhetorical Curriculum

The fundamental elements and concepts of the curriculum are derived from thoughts of the policymakers, school officials, administrators and the politicians. This curriculum is devised for the students by the experts participating actively in formation of concepts and alteration in content. The participation of educational professional cannot be ignored especially in making decisions depending upon the annual national outcomes and local institutional reports, opinion of the general public and criticism on system of education. The ideas for the structure of rhetorical curriculum are also derived from the updated knowledge pertaining to academic.

Curriculum in Use

Curriculum in use comprised of all those elements which are actually taught by the teachers in the class rooms. It is because of the fact that a formal curriculum is composed of all those things given in textbook and contents or ideas described in district curriculum guides which are usually not taught by the teachers.

Received Curriculum

Received curriculum is the curriculum for students which enabled students to actually learn in the class room. These are actually the concepts and knowledge which has been given to students not only to remember but also to practices them in their lives.

The Internal Curriculum

Internal curriculum comprised of content, knowledge and procedures in association with the realities and experiences of the apprentice. It is therefore, required to be under control of the teachers as per the learning requirement of the students. They can further explore this curriculum through instructional assessments, reflective exercises and debriefing of the discussions while calculating the real outcome of students learning in the class. It is however, surprising and instructive measure to see what is the actual purpose of getting education for the students.

The Electronic Curriculum

The electronic curriculum is a modern form of the curriculum aiming to provide knowledge to students through using innovative communication medium. It may be formal or informal in nature and the lessons taught through this curriculum can be overt or covert in nature. Students interested in learning through this media of education have extensive area to knowledge which is factually correct, informative and inspirational. Electronic curriculum is a part of overt curriculum while critically appreciating the accuracy and correctness of online information in addition to determining the reliability and authentication of the online resources.

Curriculum Change and Innovation

In academics, a change has also been considered in the part of intention and implementation of adequate system of learning and acquiring skills. Change in curriculum often occurs when there is difference between the proposed goals of learning and actually implemented curriculum (Handal, B., 2001). Inclusion of innovative features in curriculum of mathematics can be studied largely by different scholars such as Anderson & Piazza (1996), Clarke (1997), Memon (1997) and Mumme and Weissglass (1991). According to Clarke (1997), curriculum change is influenced by the following factors:

- Reform movements in general
- Reforms suggested with the need of time by teachers,
- Internal and external personnel
- Aim to bring collegiality, collaboration and experimentation in the subject teaching
- Continuous innovation in syllabi

- Outcomes of the students valued by the teachers (Handal & Herrington, 2003).

Factors involved in change and innovation in curriculum of mathematics in Pakistan is a mixture of interest and controversy elaborating general development of education in the country as an industry. The aim of alteration in the subject matter is an alignment between national philosophy, objectives and overall development of educational framework in addition to eliminating drawbacks like failure in implementation of the adequate academic framework. However, in overall process of change and innovation five standards have been resulted into the syllabus of national mathematics of Pakistan. Main objective of these competencies is to the maintenance of broader and flexible framework for teachers as well as for the students. There are five standard decided by government of Pakistan achievement of Mathematics students in Pakistan. They are as follows:

Mathematics Standards

- Standard 1. Numbers and Operations
- Standard 2. Algebra
- Standard 3. Measurement and Geometry
- Standard 4. Information Handling
- Standard 5. Reasoning and Logical Thinking (Govt. of Pakistan, 2006).

Procedure for Curriculum Development

Development of curriculum in developing countries is strongly influenced in 1960s with the appearance of new curriculum movement. Most of the developing countries curriculum for mathematics is structured on UNESCO biology project, the African Education Programmer in addition to adopting PSSC physics of the USA education development center. The Nuffield Science Program is another significant framework helping in the development of curriculum structure. All around the world the development of certain circular development cells for curriculum development has been observed during 1960s, 70, and 80s. The movement has been resulted into the development of cells for curriculum development at national level in different developing countries like India, Kenya, Malaysia and the Philippines. There are some contrived that have initiated the structuring of education department to provide comprehensive education on secondary level i.e. Nigeria, Liberia and Egypt. The development of a curriculum is a procedure used to implement broader decisions regarding learning skills, acquisition of knowledge and experience which has been adopted by various actors at different levels. This team of experts working at different levels for instance, politicians, experts and educators ate the national, provincial levels and

international levels. There are different models have been given by the team of these experts not only for the development but also for the implementation of curriculum framework at national level and one of these models is the Tyler Rationale.

The Tyler Rationale Model

Tyler rationale model is one of the most significant models in the development of curriculum. This model of rationale and objectivity tends to give a framework for the structuring of an adequate curriculum. The base of the model is built on four questions described in the world-famous book of Tyler “Basic Principles of Curriculum and Instructions”. The approach of these principles is based on logic, sequence and system.

Procedures Involved in the Development of Curriculum in Pakistan

Different set of procedures are involved in the development of curriculum in Pakistan for education at different levels. However, the study of this framework reveals the fact that procedures of developing curriculum is more or less similar to all stages of education except the curriculum structured for the tertiary level of education. It is because of the involvement of various stakeholders in the structuring of curriculum. The overall procedure for the development of curriculum is under control of subject specialists but the sole objective of the curriculum is to benefit the key entity i.e. students.

Procedure for the development of curriculum begins with the curriculum wing of the ministry of Education of Pakistan. The ministry forwards the proposal of change or restructuring of curriculum towards the centers and curriculum bureau of the provinces. Main function of these provincial centers and bureaus is to revise or re-structure the curriculum in response to the instructions forwarded by the curriculum wings the ministry of Education. Functionality of the curriculum centers is supported by curriculum committees which are composed of committee members; qualified subject professionals and personnel having required pedagogical skills and knowledge. Committee members prepared draft curriculum which is forwarded to curriculum wing and ministry of education for the sake of approvals and further recommendations. To further pursue the work on curriculum of curriculum centers, National Review Committee here to suggest suitability of the curriculum with the proposed skills of the subject matter. Each member of the NRC is nominated by the provincial government and has sufficient knowledge about the subject matter. The revised curriculum of the NRC is further pursued to the Education Secretary for the sake of consent. The agreed curriculum will next to be forwarded to the Provincial

Textbook Boards for publishing and printing purposes. The procedures involved in the development of curriculum are listed as follows:

- Request of curriculum development forwarded from curriculum wing to the provincial centers for the preparation of draft curriculum
- Committee of experts, teachers and subject specialists are called by Provincial Centers
- Curriculum plan is prepared by the PCC
- Curriculum wing received the draft curriculum
- Draft curriculum is circulated among teacher, subject specialists of schools by the curriculum wing
- Curriculum wing reviewed the draft in accordance to received comments
- Draft is scrutinized by the National Committee of Curriculum
- Ministry of Education receives recommendations from the committee
- Approval of the curriculum is provided by Secretary Education
- The duly approved schemes are further forwarded to Provincial Textbook boards for publishing of textbooks.

Curriculum of Math in Pakistan for Secondary Education

In Pakistan the history of curriculum has been started since 1975-76 which has been further reviewed in 1984-85 and later on in 1994-95. However, in 2000 and 2001 the review of the curriculum of some subjects like science and social science has been taken place in order to cope up with the challenges and requirements of the modern technologies and the impact of technical revolution on the function of society. This process has introduced the process of formulation of curriculum as a dynamic curriculum developmental process. The curriculum reforms for subjects like mathematics are still in progress for different grades of education in Pakistan. The sole objective of these reforms is to assimilate the subject matter with vibrant and responsive role of newly emerged, socio economic, technical, professional and local as well as international labor markets. It is therefore required to get improvement and restructure the curriculum to come up to the international standards. The primary focus of mathematics curriculum is therefore on the contents of the syllabus for secondary education in Pakistan. The improved addition of content will be considered to accelerate the academic development of students where a standards based program is producing vital impact on the intact curriculum. Following is the table depicting the main elements of mathematics curriculum for secondary education in Pakistan:

Curriculum for Mathematics – Grades Ix-X

Contents and Scope	Learning Outcomes /Skills
Unit 1	Matrices and determinants
Unit 2	Real and complex numbers
Unit 3	Logarithms
Unit 4	Algebraic expressions and algebraic formulas
Unit 5	Factorization
Unit 6	Algebraic manipulation
Unit 7	Linear equations and inequalities
Unit 8	Quadratic equations
Unit 9	Theory of quadratic equations
Unit 10	Variations
Unit 11	Partial fractions
Unit 12	Sets and functions
Unit 13	Basic statistics
Unit 14	Linear graphs and their application
Unit 15	Introduction to coordinate geometry
Unit 16	Introduction to trigonometry
Unit 17	Congruent triangles
Unit 18	Parallelograms and triangles
Unit 19	Line bisectors and angle bisectors
Unit 20	Sides and angles of a triangle
Unit 21	Ratio and proportion
Unit 22	Pythagoras' theorem
Unit 23	Theorems related with area

Curriculum Development Process

Curriculum development process of an effective curriculum is nevertheless a multi-step, continuous, cyclic, and a very complex process. However, the process of development can be started from the evaluation of the existing curriculum while putting efforts for the designing of a novel set of standards in addition to bringing improvement in novel program and moving backward to evaluation of the revised program. This process of curriculum development in many countries including Pakistan is carried out in a planned and systematic form while including the following eleven steps to perform:

Components of an Effective Curriculum Development Process

A	Planning	
	1	Formation of a Curriculum Development Committee
	2	Identification of key issues in a given area of concern
	3	Assessment of needs and problems
B	Articulating & Development	
	1	Articulation of standards or philosophy of program
	2	Definition of grade level and aims of the course
	3	Development of sequential objectives of the curriculum
	4	Identification of resource material for successful implementation
	5	Development of assessment elements to measure the performance of students
C	Implementing	
	1	Implementation of revised course into practice
D	Evaluation	
	1	Upgrading of the new implementation by time
	2	Measures to determine the success of the implemented curriculum

Importance of Developing Procedure

Importance of developing procedure of the curriculum is apparent from the learning experiences of the students enabling them to learn the knowledge about specific topic at any stage of development. The under mentioned diagram denotes the intentions and objectives in the curriculum development process:

In National Curriculum for mathematics, the role of developed procedures has been shifted from merely a means of providing information to measures helpful in planning of investigation tasks and management of cooperative learning environment for the students to providing a mean of problem solving (Anderson, 2009). To better assess and evaluate the expected outcomes of the curriculum, the developed procedures enabled the concerning subject to devise strategies necessary to bring improvement in learning process of the students.

Stasy (2005) found seven skills necessary for problem solving abilities of students at secondary level. They are stated as general reasoning, Heuristic strategies, ability to work with others, helpful beliefs e.g. orientation to ask questions, communication skills, personal abilities e.g. confidence persistence, organization and deep mathematical knowledge.

Following are some of the fundamental elements of saturation of the developed procedures of curriculum of mathematics for different stakeholders of the system:

- Existence of curriculum development procedure in the country enable the educational institution in building a concrete conceptual foundation in mathematics while helping them to better implement their knowledge and skills during their process of learning and working.
- Existence of developing procedures enable the concerning departments in shaping curriculum as per the need of the time without waste of time in planning and devising the matter. For instance, inclusion of geometrical concepts in mathematics syllabus would help students of secondary school to think logically, systematically and speculate perceptively.
- The devised development procedures will help authorities to better evaluate the subject matter while comparing it with the actual needs of the students to increase their learning of mathematics while integrating the use of appropriate technologies of the information rich world.
- The intention and defined objectives of the curriculum development process can be used to enhance different skills and knowledge of the students such as visualization, interpretation of mathematical expression and appropriate manipulation of the concepts.

Competition with World Option for Pak Students (Government Syllabus and O-Level)

According to the work of academic professionals the level of education in Pakistan is not up to the international standard. It is because of the fact that this system of education is structured on the framework established during British Colonial rule that had been implemented till 1947 and later on reformulated to meet the requirements of newly emerged country. In 1947 right after the division of sub-continent into India and Pakistan the colonial system need to be restricted as the main objective of the system was to educate a small proportion of the population to serve government. Irrespective of some critical alteration in the set standards of the colonial education system, still the system is having sound impressions of “colonial elitist character” a potential factor hindering the wider spread of education and rate of literacy in Pakistan. However, in Pakistan this system of education is structured on three grades i.e. elementary, secondary and tertiary grades. Education system at the secondary level is comprised of two parallel system of education e.g. local education system (SSC) and British education system (GCE or O level). The two systems are aiming to provide education at the secondary level, but they differ in terms of syllabus, resources

available to provide facilities, system of rewarding the students and teachers and the staff and the financial state of the students keen to learn.

It is difficult to assess competencies of Pakistani students at the international level because of the lack of participation in international assessment contests. However, the comparison of the syllabus of the two systems of education can help in assessing the overall situation of students learning in mathematics and acquisition of specific skills and knowledge. Following is the content analysis of SSC and GCE textbooks to better compare the two systems for teaching mathematics. The comparison can be further elaborated with the different scheme of studies used by the teachers teaching in SSC and GCE systems to get success in the examinations and teaching complicated concepts of mathematics. The sole objective of study of mathematics curriculum at secondary level is the promotion of all round, continuous and harmonious progress and development among the school students. The comparative study of the syllabus of mathematics at secondary level in Pakistan would allow better understanding about the significance of the characteristic study of mathematics in addition to following the psychological rulings and ways of inculcating the knowledge of mathematics among students of secondary level. The study would help in understanding the relationship between importance of the past experiences of the children and the available opportunities of acquiring knowledge and skills of mathematics. This comparative study of mathematics syllabus in Pakistan for secondary education would help in determining the high significance of learning cognitive thinking, attitudes and emotions and development of values among students of mathematics.

Objective

The purpose of this comparison was to trace out the factors accountable for the shortcomings in instructional objectives, contents, approaches, methods of teaching and patterns of assessment in the local (SSC) system of education.

Hypothesis

H₁: The learning experiences of the students can help in structuring the competitive curriculum of the mathematics

H₂: Comparative role of different approaches and methods of teaching in SSC and GCE system in structuring of competitive syllabus of mathematics

H₃: Availability of resources makes difference in generating gap of knowledge between students of two systems

Work Done on Similar Topics and Survey of Literature

In this section of dissertation, related and applicable literature has been reviewed in order to understand the status of knowledge regarding this topic while finding theoretical grounding for the study and informing methodological deliberation. In the national curriculum of mathematics three broad categories has been devised to literate and enhance the critical capabilities of scientifically literate students in Pakistan. The three broader categories of activities in this context involve knowing and utilization of the knowledge of mathematics, doing mathematics and reflection of mathematical knowledge and skills in their practical lives. The wider progress of these indicators is however, connected with the standards and benchmarks while describing the skills and knowledge required to be attained by the students in mathematics. A great emphasize is however, of the subject of mathematics is on elements such as high order thing, profound knowledge, substantive knowledge and association with the world ahead of getting high grade in the subject (Govt. of Pakistan, 2006). It is because of the fact the eventual results proposed in the local curriculum of mathematics are determined while strengthening teachers to implement a ample vision of pedagogies in addition to engaging themselves in practices built on the concrete philosophy of learning which is reinforcing the centrality in the learning procedures of students (Fosnot, 2005).

Literature review of the syllabus of mathematics that is being used in classrooms of Pakistan reveals the fact that there is existence of a wide gap between the ideal goals of a curriculum and the actual syllabus taught in different areas of the country. A large number of researches have been taken to evaluate the real attainment level of students in subjects of core curriculum like mathematics at different levels in Pakistan. The consistent outcome of this research reveals the low performance of students of grade 9-10 in mathematics as compared to other curriculum subjects (Ali, T., 2011). However, further elaboration of the review depicts the fact that SSC students learning in problem solving & life skills and comprehensive skills are not as responsive as they are among students learning with other system of education (GCE) (Samo, Students' perceptions about the symbols, letters and signs in algebra and how do these affect their learning of algebra: A case study in a government girls' secondary school, Karachi, 2009). According to the outcome of these studies there are several factors causing the least grade of learning in students of mathematics. It is nevertheless, according to the academic and pedagogical exploration of teachers regarding exploration of complication and hardships of student's learning is their attitude towards the subject matter which can serve as the common denominator to increase or decrease the interest of students. According to the most recent study on attitude of students toward learning in mathematics determines the fact that it is the framework and curriculum of mathematics designed for students of

secondary educations creating differences in their level of achievement (Ma & Xu, 2004). The study determined differences in achievement and learning among students as well as schools because of the implementation of differently structured curriculum. Result of the study indicate the fact that students are capable of passing low rigor items intensely require to polish their simple mathematical skills and knowledge. Further, there are items which favor female students in content domain are belonging to knowledge about concepts recalling basic facts, terminologies, numbers and geometric properties. But problem-solving level is the most favorite item or domain of mathematics for male students in Pakistan (Mash'hadi & Shah, 2008).

Definition and Description of In-Depth Learning of Mathematics

In terms of learning mathematics, the two terms i.e. in depth learning and rote learning have been widely defined and described by number of educators and researchers. In depth learning can be represented in the form of achievement of greater mathematical thinking that are differentiated in terms of development of mathematical sense and knowledge in students, strategies used for the solution of problem, development of concepts, capacities of argument in addition to the demonstration of conceptually built ideas (Jenkins, Developing teachers' knowledge of students as learners of mathematics through structured interviews, 2010). According to Skemp (1976), there are different types of learning in mathematics. For instance, relational learning and instrumental learning and the description of ideas in terms of instrumental and relational learning are mostly connected with the implemented practice of teaching mathematics. Relational learning is however, aiming to develop the sense of learning while reasoning the concepts but instrumental learning tends to attain the capacity of learning without indulging into reasoning (Mash'hadi & Shah, 2008).

In Depth Learning – A Remarkable Goal of Academic Institutions

Rote memorization of the content knowledge and in-depth learning has been working in contrast to each other as indicated from the discussion stated above. Content knowledge, which is comprised of knowledge and information about the phenomenon and principles, is enclosing the sole purpose of reproduction as per the requirement of students. Real value of in depth learning for students has also been determined in studies conducted internationally. In these studies, different benefits have been connected with the aim of promotion of in depth learning of mathematics among students (Newton, 2000). Following are some of the advantages of in depth learning:

First: in depth learning is used to persuade the basic requirement of the learners. It is because of the fact the most significant requirements of the learner

is the persuasiveness of concepts in addition to increasing keen interest about reasoning, achievement of comprehensiveness of ideas and justification in context to principles and events. Hence, it is the in-depth learning enable the institutions to meet the vary demand of satisfaction of students while giving them wider exposure to knowledge and skills.

Second: This form of learning can be used to speed up the process of acquiring capacities for innovative information in addition to using this knowledge for different conditions and situations. It has been determined through research studies that students having through knowledge of the subject matter are capable of thinking diversely while handling innovative situations (Newton, 2000). Hence, in depth learning serve as a specific set of cognitive autonomy for its holder while enabling him to interact with the world in an effective and independent manner in addition to think for themselves and making comprehensive selections. Therefore a well-structured curriculum of mathematics for students of secondary level education can enhance their sense of learning while keeping them in touch for further studies of mathematics in addition to developing their critical capabilities of reasoning and thinking analytically plus developing creative faculty of mind of the learners (Newton, 2000). Irrespective of the high significance of in depth learning for students of secondary level, it has been placed at secondary position in the current curriculum of mathematics which is truly a myth of the day. Following are some reasons that have been studies in various researches to sort out this myth of the currently implemented curriculum of mathematics.

Avoidance of In-Depth Learning and Current Curriculum of Mathematics

In spite of the mentioned reasons creating relationship between the appropriate structuring and implementation of the curriculum of mathematics in class rooms and eventually in depth learning of students, there are still some concerns existing in every class rooms of the world generally and in Pakistan particularly. It is an understood fact that teaching for learning is not an easy job for most of the academic institutions as well as for the education professionals. The learning is also not always welcome by most of the students (Government of Pakistan, 2009).

According to a survey report of World Bank (2014) understanding avoidance related to the subject of mathematics is not specific to the country of Pakistan but it is a matter of concern for most of South Asian countries like India, Bangladesh and Sri Lanka etc. In these countries the most concerning factor affecting the learning of mathematics is the non-availability of trained and responsive teachers in addition to lack of resources. The poor quality of teaching mathematics can be depicted with the existing trend of memorizing concepts and principles of mathematics and emphasize over the fast reproduction of information (Das &

Barunah, 2010). It is because of the fact in most of the Asian countries; there is no proper framework to evaluate the national learning criteria of achievement of the students owing to different benchmark standards of the curricular. As a result, the students of these countries are showing least outcome in mathematics as compared to students of developed countries (Dundar et.al., 2014). For instance, according to a survey result of Das & Zajonc (2010) a test of grade 9 based on TIMSS mathematics questions was conducted for students of two Indian States (Odisha and Rajasthan), whom had been ranked towards the bottom of sample size of 51 countries. However, learning avoidance factor can also be connected with urban and rural residential areas. It is nevertheless in South Asian countries achievements of students of mathematics residing in urban areas are obviously higher as compared to performance of students living in rural areas. For instance, the performance score of students Islamabad, Punjab and Khyber Pakhtunkhwa is typically higher as compared to students of mathematics living in Baluchistan and Sindh of Pakistan (World Bank, 2013).

Factors Affecting Learning and Performance of Effective Curriculum

Deep learning of the subject matter not only entails with the implementation of effective curriculum but also cognitive engagement of students with the subject of mathematics. It is an understood fact that students can never indulge into cognitive form of learning instantaneously which can be a fundamental aspect of learning skills and knowledge of mathematics. It is because of the fact that difference of conceptions, capabilities, skills and knowledge, interest and aptitudes, beliefs and perceptions, aspiration and ability of expression, habits and choice of selection for every student is different while making it complicated to better harmonize the vary needs of deep engagement of students with the implemented subject matter in every class room. There are number of factors affecting the quality curriculum of mathematics to deliver its vary function of developing unique problem-solving skills among students of mathematics. The factors are however, categorized into two major categories such as:

- External factors comprised of the environment denoted as parents, career aspiration, needs & demand of getting good employment opportunities
- Internal factors involve intrinsic scale of motivation affecting the number of students in the class rooms. The students entering into class rooms with intrinsic interest of learning will be highly motivated for seeking knowledge against student come to just pass the subject exam.
- Soundness of the knowledge acquired in previous classes i.e. primary classes during school education can also affect the performance of the students in secondary grades while making successful the current curriculum of mathematics of secondary grades

Whatsoever, the progression of mathematical reasoning and cognitive skills among students can be enthused through the influence of external factors which according to research of many scholars can be restricted or pushed by the main influential actor of the system i.e. “teachers” (Amirali and Halai, 2010). It is because of the fact that interaction of teachers with the students can work as an alignment turning the students to learn quality education by using effective teaching strategies. It is therefore highly emphasized the role of teachers in boosting the progress of students in school education in national curriculum of 2006 and Education Policy of 2009. There have been seen a remarkable change in the role of teachers while forcing to serve as a creator of learning environment instead of acting like a transmitter of information. This newly defined role of the teachers will help in accelerating the fruitful effect of curriculum while supporting in development of rational understanding of the mathematical concepts among students. The significant role of teachers in the promotion of in depth knowledge of mathematics among students depends upon their understanding of fundamental concepts and principles of teaching of mathematics. They can teach generic concepts of teaching while favoring students in learning mathematical concepts and principles and acquiring problem solving skills. Use of visual illustrations and examples from real life can help teachers in building strong connections between the previous knowledge of students and the more information they are required to have in the near future (Jenkins, Developing teachers’ knowledge of students as learners of mathematics through structured interviews, 2010). The degree of learning is however highly dependent upon the ways of teaching while encouragement of students to think rationally in addition to having sound concepts of mathematics is more dependent upon method of teaching as compared to using various instruments (curriculum) of teaching.

Research Methodology

The sole purpose of this research study is to conduct a comparative analysis of the syllabus of mathematics at secondary school education level. For this purpose the two implemented system of education at secondary level have been studied in this research study. To better attain the result of the research mathematics courses of Secondary School education (SSC) and General Certificate of Education (GCE). The strategy that has been adopted in this thesis is a document analysis in nature as most of the data collected from primary sources. The data sources were text books of mathematics used in the education system of secondary level of education in Pakistan and passing percentage of students in this subject under the two systems of education. Question papers of the two systems of education were separately analyzed for this study.

Documents Analysis Protocol

Document analysis is a systematic system involved in evaluation and review of the document used in the research study (Bowen, 2009). In this research study electronic research material have been used for analytical purpose and data collected from these sources is examined and interpreted to gain deep understanding of the topic and development of empirical knowledge of the content. Selected documents for the study have been analyzed in two ways i.e. superficial examination of the material and thorough examination and interpretation of the material of selected documents. This repetitive procedure of document analysis eventually resulted into combination of content analysis and thematic analysis.

While using the scheme of content analysis in this research study, information regarding the research questions have been gathered and analyzed. For instance, study of the documents helped in the identification of commitment of teachers and students during the learning process of mathematics while learning in the two systems of education i.e. SSC and GCE. The difference in degree of achievements of students of the two systems of education, their patterns of learning the course, degree of hardworking can be eventually resulted from the performance of students in board examination of mathematics and GCE examination. Moreover, the analysis would help in determining the consistent performance appraisal presented and improvement-oriented teachers concerned about the high performance of students in the examination. This quantification of content analysis of the documents retrieved from the sources, have been helpful in this research study in sorting out a crude state of the work done on comparative analysis of mathematics curriculum at secondary level of education in Pakistan. The first review of the selected documents helped in the identification of meaningful and related texts and paragraphs and data in numbers. It has increased the capability of the researcher in identification of appropriate information while separating it from the irrelevant material.

Thematic analysis of the documents enabled the researcher of this research study to have a careful review of the data while focusing on the data provided. The review of the data helped in categorizing the information as per the requirement of the research study in addition to integrating data gathered from various sources. Using these analytical techniques of data the researcher tried to keep objectivity and sensitivity while selecting and analyzing data from documents. In this research various documents regarding policies, procedures and overall performance of currently structured curriculum of mathematics have been studied and reviewed. The aim of the selected material is to enable the researcher to be engaged into a comprehensive processing of data while identifying basic themes and answer of the research questions. The analysis of the document hence helped in the determination procedures involved in

development of mathematics while comparing the appropriate curriculum of mathematics emphasizing high performance of students in the examination and attaining good problem-solving skills.

Authentication of Data

Authentication of data involves the comparison of information collected from different sources of information like journals, newspapers and websites with actual operating system. For this research study the data collected through different materials have been authenticated by observing the contents of the books of mathematics being taught in two systems of education in addition to observing the response of students studying in the class rooms plus investigating the qualification and experiences of teachers teaching in the schools.

Collection of Data

Data is collected from primary sources of information. The collected data is further analyzed and interpreted to further compare the information gathered about the two systems of education is carried out. The comparative analysis of the contents of textbooks studied in SSC and GCE system of education is carried out to evaluate the best syllabus of mathematics among them. In order to do compare the data more critically the contents of the exam papers have also been observed in this research study. For this purpose, question papers of more than twenty years related to both system of education i.e. SSC and GCE have been observed in this research study.

Data Analysis Procedure

In accordance to research questions, collected data has been further processed while categorizing into two more categories. One is carried through judgment of response of the teachers about conceptual learning of the subject matter and underground issues and myths while focusing on thematic analysis of the data given in curriculum of secondary level education. Secondly, observing the opinion of teachers and the students as well about learning of the complicated concepts of mathematics syllabus and difficulties of understanding. The outcomes of content analysis and the outcomes attained through analysis of research work generated the emergence of beliefs about bringing change in syllabus of mathematics in contexts to degree of mathematics learning among students and beliefs of teachers about teaching complicated concepts at secondary level of education. The emergent concepts are compared across the selected cases while identifying the cross-cutting key themes in addition to

formulating the findings and drawing conclusion from analysis and interpretation of findings.

Results and Findings

The analytical results of the findings of the study can be determined while analyzing the results findings issues related to matter of contents involved in mathematics curriculum which has been extracted from the contents of textbooks and question papers of the examination boards of the two systems i.e. SSC and GCE. Secondly, it can be analyzed through observations related to attitude of teachers towards teaching complicated principles of mathematics to students and learning attitude of students learning these concepts are analyzed. In this part of discussion of analysis, extracted from the content analysis of the textbooks taught in two systems of education i.e. text book of SSC published by Ministry of Education (Pakistan) for secondary education and set of textbooks used in GCE examinations. The other main point of discussion highlighted which are extracted from the review of question papers of Boards of Secondary Education Punjab, Pakistan and Cambridge International Examination are also included in this section of discussion of analysis. In the following table outcome of this content analysis are given:

Summary of Content Analysis

Contents	SSC	GCE
Textbooks	<p>Appearance of the textbook is black and white while using visible language of mathematics.</p> <p>Contents are not matching the demand of everyday mathematics i.e. percentage, interest rate, sale, purchase, interest and money etc. missing in the book.</p> <p>Contents of the book are logically sequenced.</p> <p>Existence of the problem i.e. word problem is found in the textbook of SSC for grade IX-X but in small number.</p> <p>Contents pertaining to teaching skills of problem solving are</p>	<p>Internal colorful appearance of book with imperceptible use of mathematics language</p> <p>An appropriate proportion of the topics is provided in the books of GCE for mathematics.</p> <p>Contents of mathematics book are sequenced logically.</p> <p>Word problem are found in mathematics textbooks of GCE are found in great number.</p> <p>Contents essential in developing problem solving skills is found in the books.</p> <p>Contents can be tending evidently for the appropriate application of mathematical</p>

Table Continued on Next Page

	<p>missing in the text book. Contents strengthen the provision of knowledge of mathematics for procedures and operations. Majority of the contents of the textbook is given fulfilling the learning requirement of factual knowledge.</p>	<p>procedures and function in everyday problems. Contents of the book is supporting the need of enquiry for further exploration of principles of mathematics while relating with the practical life and avoiding the limits of the syllabus.</p>
<p>Question Papers</p>	<ol style="list-style-type: none"> 1. In question papers of the secondary level of education question similar to books are given in almost paper of the board. 2. Repetition of questions in the question papers are also found in question papers of various years. 3. It is quite easy to predict the questions of next question papers that is largely because of fix design of the paper and trend of repetition of questions. 4. Questions of certain chapters are given in the question papers of SSC board examination while keeping the pattern of choice consistent. 5. Overall pattern of question paper is not flexible 6. Pattern of the paper is promoting selected study habit and a narrow down approach towards learning the concepts of mathematics 7. Least amount of questions given to examine the logical learning skill of students 	<ol style="list-style-type: none"> 1. Exact questions given in books are not found in the question papers of the GCE examination system. 2. No question in the question paper is repeated in the question papers of GCE exams. 3. it is difficult to predict the coming papers 4. in question papers of GCE examination, questions from all topics were included in the question paper 5. Overall pattern of question paper is flexible 6. Pattern of the question paper is highly promoting the comprehensiveness of habit of study 7. Logical reasoning is accumulating a large volume of paper

From the above discussion it can be stated that good performance or good outcome is the real focus of the two systems of education. In education system of

GCE only one route of getting good performance in the examination which is comprehensively designed that is a rigorous practice in its sense. However, there is not specifically designed route for getting higher performance of students devised in curriculum of SSC mathematics. It is because of the short cut route to study selected contents which is a common practice in this system of education. Most of the content of study is selected from the past question papers of the examination. The constant design, continuous repetition of questions and throwing same questions into question papers in exams are some of the factors responsible of promoting this short cut approach of study while attaining good grades in the exams. Rate of success in mathematics is based on different factors and patterns of examination reveal that the basic problem is in repetition of questions in examinations and putting the same content in the questions as given in text books is another basic problem in learning of mathematics so revolving the complete process of teaching and learning and before suggesting any other reforms in mathematics curriculum we must address assessment of mathematics.

Conclusion & Suggestion

According to the results of analysis and the findings of the study it can be concluded that the competitive edge of GCE curriculum over the SSC curriculum is because of its effective implementation owing to clarity of aims and objectives of the teachers, contents of teaching accompanying the expected aims and objectives of teaching and development of critical and reasoning and problem solving skills and knowledge among students of secondary grades. The other prime factor making GCE curriculum of mathematics as a successful tool of educating mathematics is the difference of approaches for teachers and students applied in the two systems of education in addition to different measures adopted for teaching and evaluation of the material being taught. From the research material and observations, it has been found that there is least difference in methods of teaching of the subject of mathematics in Pakistan but there is huge difference in ways of assessment and evaluation of the process of learning which is eventually creating a bridge in the effectiveness of the curriculum of mathematics in these systems of education. The other daunting fact of the least effectiveness of curriculum of SSC is one year pause in education of mathematics in context to SSC system of study and examination. This suspension of one year is another major contributor in least performance of students in the examination. Because most of the students cannot recall well the slightly touched concepts and principles of mathematics after the gap of one year and get failure in addition to getting difficulties in concept building for further prerequisite of the topic owing to having lack of updated information about the previously gathered knowledge. But there is no interruption of this sorts find in GCE system of education during the process of learning and inculcating the knowledge of mathematics to students

which is serving as another positive aspect to keep the curriculum of GCE mathematics an effective curriculum for teaching. In the light of concluding remarks of this research paper following are some of the recommendations required for bringing effective change in the curriculum of mathematics:

- It can be suggested that projected aims and objectives of the curriculum of mathematics at SSC level should be broadcasted through educators.
- It is urgently required to switch the concentration of schools towards development of problem solving and logical thinking skills among students of mathematics. The skills are however, developed via the promotion of appropriate methods of teaching of the subject.
- For the development of effective curriculum of mathematics, the principles and the subject specialists should give more attention towards inclusion of techniques and concepts used to develop logical thinking skills among students of schools. The heads of school should amend methods forcing teachers to teach mathematics in accordance to the expected aims and objectives of SSC curriculum.
- Revision of contents of textbooks of SSC is required for the effective evaluation of the mathematics curriculum. It is required to increase proportion of contents related to daily life mathematics application matter i.e. profit and loss, sale and purchase, hire & purchase, percentage, interest and money topics.
- It is also required to increase contents about geometrical figures like mensuration such as volume of 2D & 3D figures and subject matter related to trigonometry.
- It is required to increase portion of logical reasoning skills in the textbooks of mathematics of SSC system of education in addition to inclusion of geometrical patterns and sequence number.
- It is also required to include highly coherent matter in the book while integrating various areas of content via including different word problems. This can be acquired through the inclusion of repetitive outlook in textbook through the inclusion of real life problems and mathematical concepts while replacing excessive use of mathematical language with simple language plus including colorful text, pictures and illustration of the topic to enhance conceptual understanding.
- It is however, required to bring change in teaching approaches of mathematics teachers. This can be achieved with the commencement of sound structured training programs of mathematics for teachers.
- It is also required to bring change in ways of evaluation for students of SSC level both in internal school examination as well as in board examination of mathematics.

- For the evolution of an effective curriculum of mathematics it is required to bring change in patterns of question papers. The practice should involve giving different questions annually while including all concepts given in the textbook.
- In order to remove drawback of rote memorization in mathematics, it should be suggested to avoid the inclusion of similar subject matter in the similar framework as it is provided in the textbook.
- To avoid the prevailing approach of selective study and guess work of question papers, it is suggested to introduce sectioned papers allocating different areas of the textbooks every year while bringing change and minimizing the choices of selection among questions.
- For the effective development of curriculum of mathematics with effective development of mathematics knowledge and skills among students it is required to bring continuity in education of mathematics at all levels of school education.

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