# Chapter Two

## Review of Literature

Mathematics, which originated in response to society's needs to organize its transactions, is still developing and expanding and curricula are being challenged by continuous change. The need for development in mathematics curricula is a feature of our changing world. Thus it became necessary to upgrade mathematics curricula and teaching methods in a way that encompassed the modern concepts which enabled human society to evolve into the nuclear, computerized and space age (JNTIMC [1], 1976).

Mathematics is becoming increasingly significant due to the technological development of our era and becoming an inseparable part of contemporary life. therefore, mathematics curricula have changed in terms of the teaching methods and the content in order to keep in line with these cultural and technical changes (Ibrahim, et al, 1985).

The traditional view of regarding mathematics as the acquisition of computational skills is no longer sufficient or accepted. Every individual is currently facing social and economic problems that can be expressed in mathematical forms, which requires a more in-depth knowledge of mathematics. Students particularly, need to recognize, and learn to understand the new mathematical knowledge, so that they can establish the link between the contentof the mathematics curriculum and applications in real life. Consequently mathematics will make more sense to them and create positive attitudes towards the mathematics learning (Abu Zeinah, 1973).

The vast progress witnessed in the field of mathematics over the decades was strongly related to the current technological development: new concepts and approaches have been developed in the field to help solve daily problems resulting from the scientific progress. This has affected school mathematics curricula and the teaching methods in this field around the world, including Arab countries.

This chapter lists former studies dealing with the subject and reviews changes occurring in mathematics curricula in the developed countries as well as Arab countries, over recent decades.

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1- Jordanin National Team for Improving Mathematics Curricula.

## 2.1 The International Development of Mathematics Curricula

This section presents an overview of the historical evolution of Mathematics Education from 1950 to the present. The fifties along with the sixties were considered as the golden age of Mathematics education, as a result of factors,that has been shaped by:

1. international events.
2. professional organizations.
3. the developments in scientific methodologies of inquiry.
4. theoretical explanations of how children learn and come to understand Mathematics.
5. the developments in the field of psychometrics and assessment

(Rivera, 1997).

Given this manifest progress, many countries sought to expand their approach to the teaching of mathematics after realizing the significance of this subject in the development process of the nation as well as in the employment of current technology. Mathematics curricula were also affected by the efforts of the United States to develop both the content and the teaching methods. The efforts by United States were a reaction to the launch of the Soviet satellite Sputnik in 1957. Since then, mathematics curricula in the United States and other countries such as Japan, Germany and others were subject to revision in order to improve students' performance (Knuth & Jones, 1991).

Since the sixties up until to the nineties, there have been strong calls all over the world to upgrade mathematics curricula. Several countries sought to achieve this through implementing projects which involving new teaching strategies and recent studies have been conducted aimed at evaluating current teaching programs and comparing them with preceeding curricula.

The United States' efforts to achieve this goal, particularly during the sixties, resulted in the rise of the "New Mathematics Movement", a movement that played a major role in upgrading mathematics curricula in the USA as well as in most European and Third World countries, As a result of these calls and efforts, curricula became concentrated on mathematical structure rather than on the ordinary mathematical skills. More concern was given to the approach through which the student finds the correct answer rather than the correct answer itself. Moreover, this movement called for the study of mathematics as an independent and distinct subject (Knuth & Jones, 1991).

Another factor that has been universally echoed in government schools curricula (including those in Arab countries), is the adoption of current mathematics trends. Special groups were formed amongst developed countries to design updated curricula as a response to such trends;

School Mathematics Study Group (SMSG): started in 1958 in the USA included a group of specialists in mathematics working to design School mathematics books that would represent a breakthrough, away from the frame work of traditional curriculum and fitting the current spirit of education however this curriculum was subject to many amendments.

The Organization for Economic Cooperation and Development (OECD): this organization started in 1960 in Europe and contributed to the formulation of several reports on the development of mathematics curricula in government education. Amongst these reports was a proposed mathematics textbook as a reference to guide member countries. The proposed curricula involved radical changes in the concepts of current mathematics. Some of the countries that benefited from these include; Germany, France, Italy, Japan, England, and the USA.

School Mathematics Project (SMP): This project started in England in 1961. The result was that a novel curriculum was designed with a contemporary spirit and new subjects to be discussed. This curriculum was first taught in the academic year 1962/1963.

Nordic Committee for Modernizing School Mathematics (NCMSM): started in 1967, all Nordic countries; Denmark, Finland, Norway and Sweden were involved in this committee which designed a curriculum for modern mathematics to be used as a reference for committee members. This curriculum evolved as a unified framework where the traditional divisions of mathematics disappeared but were presented in the forms of arithmetic, geometry and analysis; the new curriculum came into existence and put emphasis on new concepts and topics and a binary order (sets, operations) was given a central role.

Comprehensive School Mathematics Project (CSMP): A project started in Southern Illinois University in 1968. A novel contemporary curriculum was designed that depended on a series of varied activities plus a group of instructional tools. It aimed at presenting an educational program that encompassed individual and group learning methods, especially regarding the first two elementary stages. As for the secondary school stage, an integrated curriculum for contemporary mathematics was specially designed.

Secondary School Mathematics Curriculum Improvement Study (SSMCIS): this study came into existence in the USA during the 1960s and was done by teachers of Columbia University. Aiming to present a new integrated curriculum, it included all the mathematics that is considered essential through a first year university program, specially the fundamental structures of number systems, Algebra, linear algebra, probability and its applications, mathematics related to computers and the calculus (analysis).

Nuffield Primary Mathematics Project: The project started early in the 1960s in the United Kingdom, supported by the Nuffield Foundation and the School Mathematics Project (SMP). The project aimed to introduce "Modern mathematics" into the curriculum of primary and secondary school. The Nuffield Foundation places special emphasis on curriculum development and through its curriculum center aims to explore new approaches to the teaching and the learning by developing, managing and supporting curriculum projects' (especially practical developments). Nuffield researchers work with small groups of teachers across the UK to develop new approaches and materials for the use in schools and by publishing their findings, sharing them with schools and colleges across the country **(2)**.

International study group for Mathematics Learning (ISGML): In late 1961, Dr. Z.P. Dienes had worked with Bruner and developed an interest in theories of learning. His approach reflected academic rationalist aims. Dienes established the Adelaide Mathematics Project (AMP), which undertook experimental work on the teaching structure in mathematics, using concrete aids at several primary schools. The project based on using psychological understandings to provide children with a structured, active, and interesting learning environment in order to achieve a more stable learning of mathematics ideas and the activities were developed to see many aspects of elementary mathematics idea of Set and the involvement of children in the portioning of these sets leads on to the notion of subsets, inclusion and the complement of a subset. Representation of these ideas involves the use of Venn Diagrams which in turn leads to the introduction of the concept of union and intersection of sets. Elsewhere in the book there is a discussion of mappings, one-to-one correspondence, conservation, ordering, inclusion, cardinality and ordinarily, as exemplars of more advanced ideas of Groups and Fields. Dienes believes that probability could and should be taught to

2 http://www.dti.gov.uk/ost/ostbusiness/puest/sciconn/nuffield.html

young children, because of his experiences with teaching the logic and what he knew of the work done in this field. The AMP was affiliated with the ISGML, which produced the first quarterly bulletin and later the Journal for Structural Learning, whose advisory panel contained many prominent international educators. ISGML is an international network of people. the group has members from many countries, such as; Italy, Canada, England, France, Germany, South Africa, and USA…etc[3].

Generally, mathematics curricula were characterized by some distinct features during the sixties: unified concepts like sets, relations and functions were included. Plus more concentration was put on mathematical structures, group, fields, and Isomorphism (Abu Zeinah, 1997 ; Abu-Sel, 1999).

Also, there was an increasing emphasis on deductive proof, especially in the secondary stage, in addition to the special attention given to mathematical terms like the distinction between concepts and their denotation an example is the distinction between numeral and number. New topics were also included in the curricula like statistical inequalities and methods to solve them; organizing of numbers to non-decimal powers and electronic arithmetic science (Khasawneh, 1985). Further features of this decade were the transfer of some mathematical concepts from the higher to the lower stages for example the unification and integration of some concepts such as arithmetic, algebra and geometry under the one term of mathematics and the reduced concentration on Euclidean geometry and Trigonometry (Khasawneh, 1985 ; Abu Zeinah, 1997 ; Abu-Sel, 1999).

During the seventies, as a result of the increasing concentration on mathematical structures, unified concepts and abstract algebra a negative reaction arose amongst education staff, teachers and parents towards the Modern Mathematics Movement as well as the criticisms of education specialists like Morris Kline who wrote a book entitled "Why Johnny Can't Add". This book was a best-seller and was popular for its attack on the new mathematics for failing to teach addition, subtraction, multiplication, division, and the increased attention given to more intelligent students rather than to those less gifted (see website [4] ).

The result of the concentration on mathematical structures and abstract concepts was that students knew the meaning and characteristics of groups and numerical systems, but were unable to do the regular calculations (Khasawneh, 1985).

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3 http://www.ugr.es/~iase/isgnewsletter/v9ju96.html#dos

4 http://www.selu.edu/Academics/Faculty/nadams/edu692/mathematics.html

More importantly although, the curricula gave great significance to the logical structure of the material but on the other hand neglected the psychological structure of the student, which should be based on the needs and capabilities of the student as well as the need to concentrate on teaching the approach to problem-solving through the learning of the basics, rather than to concentrate on the structure of the subject itself (Khasawneh, 1985; Wiles, et al, 1978; Knuth & Jones, 1991).

Therefore, the need arose for teaching programs that gave significance to the problem-solving approach as a foundation of understanding and accumulating the knowledge of new mathematics, plus the need to use different strategies towards problem solving and adapt to different situations (Abele, 1999).

In light of these criticisms call for the reform of mathematics curricula arose. The "Back-to-Basics Movement" appeared during the seventies, calling for the stress to be on the fundamental mathematical skills that are basic to the development and evolution of the school textbooks. In this regard, the National Council for Supervisors of Mathematics (NCSM), in the USA issued a paper in which it specified a list of the basic skills and abilities which needed to be enhanced (Denmark and Kepner, 1980).

In 1977 the National Council of Supervisors of Mathematics (NCSM) issued and identified 10 basic mathematics skills, which were essential and should be taught in grade 1 through 12. The list of the basic mathematical skills as the following:

1. Problem solving.
2. Applying mathematics to every-day situations.
3. Alertness as to whether the result is reasonable or not.
4. Geometry.
5. Estimation and approximation.
6. Appropriate computational skills.
7. Measurement.
8. Using mathematics in prediction
9. Reading, interpreting, constructing tables, charts and graphs.
10. Computer literacy. (Denmark et al, 1980; see in line: the website [5] ).

During the eighties, a strong call for improvement arose following the report "Nation at a risk". This report was accompanied by similar reports in the field of mathematics, like "The Agenda for Action" which was followed by "Everybody Counts"and

5 http://www.selu.edu/Academics/Faculty/nadams/edu692/mathematics.html

“Curriculum and Evaluation Standards for School Mathematics”. This last document had the greatest effect on improving the teaching of mathematics in the public schools of the United States and was considered a guide to the teaching of mathematics in most developed countries (Rivera, 1997; Hurley, 2001).

In 1989, the National Council of Teachers of Mathematics (NCTM) issued a document of major importance for improving the quality of mathematics education in Kindergarten to grade12. This document, "Curriculum and Evaluation Standards for School Mathematics," contains a set of standards for judging mathematics curricula and for evaluating the quality of the curriculum and student achievement. It represents the consensus of NCTM members about the fundamental content that should be included in school mathematics curriculum, establishing a framework to guide reform in school mathematics. It also gives a view of what content priority and emphasis to the mathematics curriculum should be included over the next decade.

Technology is changing the workplace, the home and daily life. Moreover, the mathematics a person needs to know has shifted and new mathematics is being created as new technological applications emerge. The document involved objectives of mathematics education, which needed to be transformed to meet the critical needs of the society: An informed electorate, Mathematically literate workers, Opportunity for all students and Problem-solving skills that serve lifelong learning (NCTM, 1989; Suydam, 1990).

The document standards also stated five aims for students: to learn to value mathematics, to learn to reason mathematically, to learn to communicate mathematically, to become confident of their mathematical abilities and to able to solve mathematical problem.

The document included two kinds of standards represented by 54 standards for curriculum development and Evaluation: 40 standards for content, distributed at three Grade-level groups: 13 standards for K-4, 13 standards for 5-8 and 14 standards for grades 9-12.

The 13 standards for K-4 grades are*:* Problem Solving, Communication, Reasoning, Mathematical Connections, Estimation, Number Sense and Numeration, Concepts of Whole Number Operations, Whole Number Computation, Geometry and Spatial Sense, Measurement, Statistics and Probability, Fractions and Decimals, and Patterns and Relationships.

The 13 standards for grades 5-8 are: Problem Solving, Communication, Reasoning, Mathematical Connections, Number and Number Relationships, Number Systems and Number Theory, Computation and Estimation, Patterns and Functions, Algebra, Statistics, Probability, Geometry and Measurement.

the 14 standards pertaining to grades 9-12 are: Problem Solving, Communication, Reasoning, Mathematical Connections, Algebra, Functions, Geometry from a Synthetic Perspective, Geometry from an Algebraic Perspective, Trigonometry, Statistics, Probability, Discrete Mathematics, Conceptual Underpinnings of Calculus and Mathematical Structure.

The Evaluation, including 14 standards, provides strategies to assess the curriculum, instruction, and program. Three standards pertaining to general assessment: Alignment, Multiple Sources of Information, and Appropriate Assessment Methods and Uses. Seven standards concern student assessment: Mathematical Power, Problem Solving, Communication, Reasoning, Mathematical Concepts, Mathematical Procedures and Mathematical Disposition. Finally, 4 standards on the program evaluation: Indicators for Program Evaluation, Curriculum and Instructional Resources, Instruction, and Evaluation Team.

During the 1990s, the field of mathematics education witnessed reformed efforts, aimed at improving mathematics instruction for all students. As a result of technological advancements, national movements and mathematical workforce expectations, recommendations for the restructuring of mathematics programs have emerged (NCTM, 1989 ; Rivera, 1997 ; see available website[6] ). The mathematics professionals of the National Council of Supervisors of Mathematics and the National Council of Teachers of Mathematics in emphasized mathematics program and issued a document encompassing the assessment standards for school Mathematics (NCTM, 1995). The assessment standards aimed to: reflect the mathematics that students should know and be able to do, enhance mathematics learning, promote equity, become an open process, promote valid inference and be a coherent process.

Over the past decade, many efforts have been made to reform school mathematics to reflect the recommendations made by the National Council of Teachers of Mathematics (NCTM, 1989) presented in the Curriculum and Evaluation Standards for School

6 http://www.selu.edu/Academics/Faculty/nadams/edu692/mathematics.html

Mathematics. The release of updated standards, Principles and Standards for School mathematics (Trafton, et al, 2001).

In 2000 the NCTM issued a new document "Principles and Standards for School Mathematics" (*see appendix: 10*) to improve mathematics education in light of living in a changing world, new knowledge, tools and new ways of doing and communicating mathematics continue to emerge and evolve.

The document "Principles and Standards for School Mathematics" is organized into four main parts:

1. Principles for school mathematics.
2. Standards for mathematics education in (k-12) grades.
3. Standards for separate grade bonds: (k-2), grades 3-5, grades 6-8 and grades 9-12.
4. Discussion of the steps needed to move toward the vision embodied in the standards.

The principles are statements reflecting basic precepts that are fundamental to high-quality mathematics education. The main themes of the six principles are equity, curriculum, teaching, learning, assessment and technology. The 10 standards describe what mathematical instruction should enable students to know and do from kindergarten through to grade 12.

The first five standards describe mathematical content goals in the areas of: Numbers and Operations, Algebra, Geometry, Measurement,and Data analysis and probability.

The next five standards address the process of: Problem solving, Reasoning and proof, Communication, Connections and Representation.

## 2.2 The Relative International Studies

Mathematics has greatly benefited from recent theories of education, which helped to build the curricula in consistence with the mental progress of the child. Mathematics curricula faced the drawback of the tendency to memorize rather than to understand and the lacking use of proof - except in Euclidean geometry – subsequently, these curricula were the subject of several evaluation and adjustment projects. This part will be dedicated to a brief review of those studies and projects.

The National American Evaluation Project (NAEP) recommended the improvement of the quality of education by improving curricula and providing more training for

teachers. These recommendations were put forward following a study aimed at testing the comprehension of some basic concepts of current mathematics by students aged between 13 and 17. The study revealed that students suffer general weakness with regard to such basic skills as computation, problem solving, verifying the results and the ability to estimate and approximate (Carpenter, 1975).

Giesbrecht, (1980) recommended necessary improvements in the mathematics curricula and teaching methods in statistics, Probability and Business and Consumer Mathematics. His recommendations were based on a study he conducted on ninth to twelfth grade students in Saskatchewan area in Canda, to evaluate their extent acquisition of the basic skills. In his study, Giesbrecht used the list of basic mathematical skills designed by the National Council for Teachers of Mathematics (NCTM) in 1972. Results of the study revealed that students ( except those in the $9^{th}$ grade ) performed well in most skills of statistics, probability, geometry, and Business and Consumer Mathematics.

As an experiment in developing a unified six-year, The Second School Mathematics Curriculum Improvement Study (SSMCIS) was begun by the teachers college of Columbia University. Restriction of traditional content were to be discarded in favor of a syllabus that would encompass all the mathematics considered essential through a first year University program, especially the fundamental structures of Number systems and algebra, linear algebra, probability and its applications, mathematics related to computers and calculus. So that the SSMCIS was designed for the most capable students. The procedures of developing were followed by syllabus conferences, writing experimental textbooks, the education of the classroom teachers, pilots' class teaching, and evaluation of outcomes.

In 1966, the team of developing outlined the scope of six-year program, and was given to twenty teachers who would teach the experimental course, after that was considering revisions of the material. During the 1967/1968 school year, the preliminary version of course 2,and the Revised Version of course 1 were tried out in the pilot schools. This procedure continued each summer and the following school years until 1973 (Howson, et al, 1981).

Shirely (1984), conducted a study aimed in examining the effect of teachers participation in the development and implementation of mathematics curriculum, this study took place in three states of northern Nigeria (Benu, Kaduma and Sokoto). The study involved a review of the processes of mathematics curriculum development in

Nigeria and the role of teachers participation in the development process. The experimental group met for a training on the new knowledge of the curriculum ,but the teachers of the control group did not receive any training. The Results showed a positive correlation between the attitude towards the new curricula and the concept of change of both the trained teachers and those who had previously participated in improvement processes. The study recommended early participation of teachers in improvement processes and training on those curricula and also stressed the need for ongoing communication between the teachers and those responsible for designing the curricula.

Also the major purpose of the McConnell study (1987) was to identify and classify objectives for teaching Secondary School Mathematics in the United States during the period 1918 – 1982. The period was divided into seven sub-periods. Selected professional periodicals were examined for statement objectives of secondary school mathematics. The statements were catalogued into knowledge, process, attitudes and interest or cultural awareness categories. The resulting data was recorded within and across sub-periods according to frequency of occurrence category, authorship and the year. The most important aspect of this investigation included the objectives for the 1918 – 1982 period, which were philosophical, sociological and political aspects, processes, skills and technique. He also found the number of the statements for the objectives for all sub-periods decreased by one to three objectives of the first sub-period.

In summary, current trends in the teaching of mathematics in developed countries like the United States, Japan, Germany and others, urge us to revise our curricula and teaching methods in all public schools. This will require a mode of accurate planning and preparation in light of current demands and the society we seek to achieve through our teaching programs.

Therefore, to recognize the developments and changes in Mathematics education in the progress of a country and the effect of the political factors as a reason in these changes, Germany is a suitable example for this.

## 2.3 Development of Mathematics Education in Germany

The Federal Republic of Germany has 16 states, each with both its own ministry of Education as well as its distinctive set of political, religious, and cultural traditions. While Germany is a small and relatively homogeneous nation, its constitution guarantees the cultural sovereignty of each state. In contrast to the high degree of centralization that exists in some other industrialized countries, the responsibility for primary and secondary schooling in Germany rests with the state and district authorities. The federal role in education is limited mainly to the regulation of Educational and Training assistance, including Vocational Education and the promotion of scientific research. While all German states have basically the same Education structure and core curriculum, abide by the uniform examination requirements for the Abitur (the school-leaving exam that follows attendance at a Gymnasium), and recognize school completion credentials from around the country, there are differences in the actual practice (Ashwill, 1999, p. 19).

Curriculum changes in the former German Democratic Republic (GDR) were influenced by changes of the school system and the general goals of "Socialistic Education". The introduction of the "Socialistic comprehensive school",(Sozialistische Einheitschule) from grade 1 to 10 meant teaching mathematics to all.

Mathematics teaching in Germany witnessed changes and developments influenced by the Organisation for Economic Co-operation and Development (OECD) recommendations of 1961 and 1964. A discussion began on the strengthening of school mathematics, because mathematics teaching at the Gymnasium was centered on the goal of "General Human Education.". Pure mathematics and its formalisms were more important than applications. The intention was to close the gap between school and university by introducing the idea of "modern mathematics" into school. Therefore sets, structures, mappings and logical concepts were to be introduced into mathematics teaching and replacing the teaching of arithmetic and practical applications by a more mathematical education was discussed. As a first step, elementary algebra was introduced.

The most important change in mathematics teaching happened in 1968, represented in the standing Conference of Ministers of Education and Cultural Affairs of the states of the Federal Republic of Germany (KMK), which passed the "Recommendations and Guidelines on the Modernization of Mathematics Teaching at General Education

Schools." During the next four years, all states had to renew their syllabi for every type of school according to the guidelines from 1968. The recommendations were essentially general remarks on the importance of mathematics. The progress in mathematics during the previous decades and the use of "modern mathematical thinking" in fields important to science, economics and society had forced the modernization of mathematics teaching. As one of the consequences, concepts such as the use of sets, mappings and structures should be fundamental ideas represented in all suitable topics. In 1976, some revisions were made that considerably reduced these specific consequences. During the 1970s each state tried to incorporate guidelines into its own mathematics syllabi. Since each state worked independently, the 10 states produced 10 different results. Several items were not accepted by all states and some topics were put into other grades.( Weidig, 1997).

The political changes since 1989 in the German Democratic Republic (GDR) is considered to be the main reason behind the change and development of mathematics Education, refering mainly to the reunification of East Germany and West Germany in 1991. The task of the whole of education consisted in forming young people to become convinced socialist citizens according to the program of the former socialist party (SED). first of all the majority of teachers had regard the needs of their students and tried to help them to develop their abilities through Mathematics Education.

After the reunification of Germany in 1991 the new states had to organize their school Systems and to develop new curricula. It was not a great problem to develop new syllabi in mathematics education, because the differences with respect to the contents were not very remarkable between the new and the old states. It was mainly probability and statistics which had not been taught in the former GDR.

The specific function of Mathematics teaching represented with providing pupils with knowledge of the fundamental mathematical concepts, theorems, rules, methods, procedures and their relationships and the ability to solve internal and external mathematical problems. Development of the students' personality with respect to their ways of thinking; through using experiences of the acquisition and application of mathematical knowledge; developing of a positive attitude and a readiness for intellectual work. As a result the Students should be interested in mathematics and should take pleasure in working on problems, in overcoming difficulties, in working alone as well as in a team. Also, in general, they should understand the role of mathematics as "part of the recognition process in the social practice".

The contents of mathematics education in grades 1 - 10 were:

1) natural numbers, fractions, rational numbers.
2) elementary geometrical structures such as points, straight lines, segments.
3) triangles, four-sided figures, circles and their main characteristics.
4) simple solids, their surface area, their volume, and their representation in the plane.
5) linear, quadratic, exponential and trigonometric functions; linear and quadratic.
6) equations, linear inequalities, linear systems of equations, studied in a systematic way.

The formulation of rules and the development of methods, with definitions of concepts, proofs of theorems and a consequent use of mathematical language (Henning, 1997).

## 2.4 The Development of Mathematics Curricula in the Arabian World.

Mathematics curricula throughout the Arabian world have been subject to improvement and progress. A series of changes and trials having been divided into Arithematics (computation), algebra and geometry (Bashoor, 1973). In general they were affected by the wave of reforms pervading Arab countries and driven by the changes taking places in western countries from where the reforms and where the transfer of technology originated. They were also internally motivated by educational scholarship, publications and membership of relevant international organizations, like UNESCO projects of Education for example.

In 1966 the UNESCO Organization launched a project to improve mathematics' teaching in Arab countries. This project was in accordance with the resolutions of the conference of Education and Planning Ministers held in Tripoli, Libya, which was followed by the first seminar on the topic. This was held in Cairo in 1969, under the supervision of UNESCO Organization, to review the methods used to teach mathematics. The result of this seminar was the formulation of national committees in several Arab countries, assigned to improve the teaching of mathematics in member countries. Jordan was amongst the member countries (Al-Mussaddeq, 1985).

Some Arab countries implemented the programs and textbooks proposed by the UNESCO Organization , which initially involved 3 new textbooks for the secondary stage. This step was followed by a one-month training session held each September in

1970, 1971 and 1972 under the supervision of the Jordan National Team for developing Mathematics Curricula and Teaching Methods. These curricula were generalized and adopted for all secondary students in Jordan in the academic year 1975/1976 (Khasawneh, 1985).

The Education project of the UNESCO Organization Followed by developing the content of mathematics curriculum of secondary stage, but the developing of mathematics content in the rest stages adopted by the Arab Organization for Education, Culture and Science. Arab schools began serious steps to stress the basic mathematical skills in textbooks, with adjustments made to the curricula designed within the framework of those proposed by UNESCO and the Arab Organization for Education, Culture and Science. In many cases adjustments were made locally when the Jordan National Team for Promoting Mathematics Curricula instituted improvements for the preparatory stage and secondary stages from grades 7 through 12. As for the elementary stage, its curricula were designed as part of the Project for the Unification and upgrading of Mathematics Curricula adopted by Jordan and Syria (Abu Zeinah, 1985 ; Hiyasat, et al, 1990).

Other similar regional projects designed under the policy of "unification and improvement" and catering for basic mathematical literacy and implementation of skills were initiated in other countries; most eminently was the project for "Unifying and Improving Mathematics Curricula in Gulf Countries". This project started in 1984, covering all stages from grade 1 through to grade 12. (See website: AL-Sharqawi [(2)] ).

In September 1987, the First Conference of Promoting Education was held in Jordan, reviewing all aspects of the educational system and taking the process of improving curricula as the first priority for educational development. The fifth and seventh recommendations of the conference called for improving mathematics curricula by integrating them coherently with those of the elementary stage and taking into consideration the needs and capabilities of the students.

The conference also recommended that more concern should be given to the following key elements:

- Basic mathematical skills and their relevance in the real world.
- Trigonometry laws.
- Spatial geometry.

(2) www.angelfire.com/sc3/mathgroup/nowmath.htm

- Solving equations.
- Upgrading problem-solving ability of students.
- Reduce abstract concepts related to functions and relations, mathematical systems and groups.
- Increasing number of weekly periods (with average one period) for every grades 5th to 12th (Jaradat et al, 1988).

To summarize, the above mentioned projects had the following common points:

- They all aimed at the improvement of mathematics curricula both in terms of content and teaching methods;
- They followed the experimentation approach, trying to improve educational tools.
- Teachers had training sessions during which the educational background and tools used to illustrate the new content were reviewed;
- The development process supervised by specialists in mathematics, from universities and Educational colleges.

## 2.5 The Local and Arabic Relative Studies

Al-Malaq (1984) conducted a study aimed to describing and comparing mathematics curriculum in Japan with mathematics curriculum in Saudi Arabia. The content of mathematics curriculum was analyzed and compared between the content of curriculum across all grades (1-12) in both countries. The results of the comparison indicate that there is a clear difference in terms of mathematical concepts and methods of content display between mathematics curriculum in Saudi Arabia and Japan. The most significant differences were as follows: Curriculum of Saudi Arabia start the progress of fractions concept from the first grade and across the grades with spiral method but the Japanese curriculum started in progressing fractions concept from grade two and deeply across the grades with spiral method. Curriculum content of Saudi Arabia consist on concepts of ratio, averages, powers and exponents from the 4th grade and the proportion concept in the 5th grade but the Japanese curriculum content consisted on concepts of ratio and averages in the 5th grade and the concept of proportion in the 6th grade, also the curriculum content doesn't consist of any concept for powers and exponents across the (1-9) grades directly. There were also differences in progressing and using abstract method in display concepts of algebra and geometry

for middle stage (7-9), such as: Saudi Arabia concern on abstract method in algebra through the concepts of sets theory and operations, equations and relations, analytic and Euclidean geometry; but the Japanese curriculum use the traditional methods. Also the Japanese curriculum give the importance of computer as a major subject in studying for secondary grades, but the curricula of Saudi Arabia doesn't consist this subject for any grade.

Abu-Zeinah (1985) conducted a study aimed to analyze the curriculum content of mathematics for elementary stage in Jordan. The basic mathematical skills necessary for each individual were identified. The teaching of the basic skills was also investigated and the acquisition of these skills by third grade and sixth grade students was also done. The analysis of the mathematical content was done based on a matrix of two dimensions (mathematical knowledge and basic mathematical topics). The mathematical knowledge was classified into concepts, generalizations, algorithms and skills, problems and applications. Six main mathematical topics were identified to constitute basic mathematical skills: Numbers and Numeration; Number Theory; Mathematical Operations, Units and Measurement; Geometrical Concepts and Figures, Mathematical Relations and Application.

The mathematics syllabus at the elementary stage emphasized mathematical operations, 41% more than the other topics. The second topic, which the syllabus emphasized, was Numbers and operation (22%) followed by geometrical concepts and figures (15%). Other topics received little attention. However, the implementation of the syllabus by teachers was not carried out in accordance with the curriculum viewpoint. Discrepancies among and between teachers with regards to the curriculum were clearly noticed. Acquisition of mathematical skills by the third grades students were acceptable (58%), but the performance of sixth grade students were very low (33%).

Al-Jarah (1986) conducted a study aimed to evaluate mathematics textbooks for preparatory grades (7-9) in Jordan and studied the effects of geographical environment achievement and the gender. Study sample consisted of 45 teachers' male and female and 209 students who were chosen from 17 schools (from schools of education directorate in Irbid) by random method. The results of the research indicated that there was no interconnection between the textbooks units. Also repetition existed of some subjects during the grades and the number of lessons, which is limited for studying

mathematics books, not enough for every book. The results also showed that the achievement level of students reduce from student estimation degree for book.

The National Team for Improving Mathematics Curricula also conducted a study in 1987 aimed at evaluating Jordanian mathematics textbooks and the teaching techniques for all grades. The study involved a set of proposed solutions and recommendations designed to improve students' knowledge and achieve the objectives of the curricula. In light of the results of this study, the mathematics curricula for the elementary stage were described as traditional in content. The introduction of mathematical topics for the students of grades 1 to 3 is compatible with the progress knowledge acquisition and is in line with the new approach to mathematics textbooks and teaching methods. On the other hand, the $4^{th}$ grade textbook is crammed with geometric concepts, operations and generalizations. The methodology used to introduce mathematical topics is not realistic, not in line with the current approach to mathematics, nor does it motivate students to interact during classes. For the preparatory stage curricula (grades 7 through to 9), the content is in line with contemporary theories teaching methods are exploratory and interactive. The secondary stage curricula took a different approach using logical organization and abstract math while taking in to consideration the utilization of basic skills (MOE, 1988).

Abu-Ali (1989) also conducted a study aimed to evaluate mathematics textbooks for Jordanian secondary, through a sample consisting of 43 teachers' and 286 students, selected from 15 schools( schools of education directorate in Irbid) by random method. Two questionnaires were developed by the researcher for the purpose of the study and the researcher was interested in constructing an evaluation of books on; their general shape, content, activities, methods of assessment and developing the positive attitudes of student. The results of the research indicate that, mistakes existed in the printing of the textbooks, and the textbooks don't encourage, or develop the positive attitudes of the students. Therefore didn't satisfy the needs of the society or the students.

The National Center for Human Resources Development (NCHRD) prepared and issued a report about the performance results of $8^{th}$ grade students, which participated in the International study of mathematics and science in 1991 and 1999 as follow:

In 1991, Jordan participated in the second International Assessment of Educational Progress (IAEP) aiming to assess and compare student achievement levels with achievement levels of participating countries at the mathematics tests that covered five mathematical topics: Numbers and operations, Measurements, Geometry, Data

analysis, and Algebra. The results of the study showed a low level in performance in Jordan, compared to those levels in each of the participating countries, with average percentage 40% for correct answers, Jordan was ranked 18th out of the 20 countries participating.

The significant reason behind the low level of performance was test content does not represent the content of the mathematics curriculum and textbook. In addition, the methods of teaching used did not focus on higher level of thinking skills, but its mainly focused on knowing and memorizing concepts and mathematical facts. In 1999, Jordan participated in third International Mathematics and Science Study (Repeat) (TIMSS-R). This study revealed a low level of achievement by Jordanian students', who scored an average 428 mark, in comparison with general average of 487 marks by the other participating countries. This placed Jordan in 32nd place, out of 38 countries taking part in the mathematics test.

Finally, in light of the results of the TIMSS-R study in 1999 and the results of IAEP study in 1991, in which Jordan participated, the NCHRD report indicated that a clear improvement in the level of achievement by Jordanian students across the ten years ago. This improvement was due to the reform and educational improvements which were taken by the Ministry of Education in Jordan

Dweikat (1996) conducted a study purposing to evaluate mathematics textbooks for the ninth grade in Jordan, from the viewpoint of mathematics teachers and supervisors. The study focused on two groups. The first group of teachers consisting of 150 males and females who teach mathematics for the ninth grade in schools from two directorates: Irbid the first and Irbid the second in 1994/1995. The second group of supervisors consisting of 42 mathematics supervisors who worked for all directorates of education in Jordan during 1994/1995. The sample was chosen randomly from the population and it consisted of 120 males and females teachers and 35 supervisors. The instrument consisted of a questionnaire developed by the researcher for the purpose of the study. The results showed that there were significant differences between the teachers' and supervisors' estimation of evaluating the textbooks; due only to the content. In light of the results the researcher recommended that the number of classes should be increased and the units of the textbooks needed to be logically rearranged.

## 2.6 The development in Jordan

Jordan began to review its education system comprehensively in the mid-eighties with the belief that Human beings are the best resource for achieving comprehensive economic and social development. Jordan, within the framework of comprehensive development, paid special attention to the educational Process, which is very crucial to the process of development and progress, both economically and socially. This era, which is characterized by the expansion of knowledge, technological revolution and accelerated Informatins, necessitates the development of an educational formula, capable of keeping pace with recent scientific, technological and educational developments, interacting with them and gearing them towards the objectives of education for all (MOE, 1996).

The Jordanian education system is currently undergoing a comprehensive Educational Reform Program (ERP) which was launched in September 1987. The Aims are to provide students with a high quality of basic and secondary education as well as to increase their vocational train ability and flexibility in adjusting to the changing market conditions. The Government's implementation strategy for the ERP as a whole, had been designed against three criteria: feasibility, flexibility and affordability. The target aim of the ERP is to enhance students' achievement levels by:

- Restructuring the school system and improving the quality of teaching and learning.
- Developing an institutional structure responsive to the system's Long-term qualitative and quantitative needs.
- Developing the system's capacity to evaluate the ERP and sustain it on a self-renewing basis ( AL-Hendawy, 1992)

One of the most important outcomes of the First National Conference For Educational Development (1987) was the issue of the Provisional Education Act No.27 for the Year 1988. Which, after being passed by the legislative body, became No.3 for the Year 1994.The act defined the outlines of the education system in Jordan which comprises the following cycles:

a- Pre-school education : kindergartens (2 years ) .

b- Basic compulsory education (10 years ) .

c- Secondary education (2 years ) . (MOE, 1994).

The whole reform plan was subdivided into seven national programs, covering the following areas: Curriculum Development, Textbook Development, Teacher and Supervisory Staff Training, Educational Technology Development, Educational Facility Improvement, Technical Vocational Education & Training, Educational Research and Development.

The first phase of the Educational Development Plan (1989-1995) concerning the development of human resources was implemented and achieved a good part of its objectives in the field of :

- Teacher training and certification.
- General examinations and school tests.
- New curricula and textbooks.
- Educational technology.
- School buildings.
- Restructuring the education system.
- Vocational Education and Training.

The second phase of the Educational Development Plan (1996-2000) aims at achieving and deepening the qualitative impact of educational reform through:

a- Staff development
b- Developing examinations /assessment
c- School - based innovations
d- Technical and vocational education and training ( TVET)
e- Developing pre-school education
f- Non-formal education. (MOE, 1995 a).

Innovational efforts in this area during the two academic years 1994/1995 - 1995/1996 included the Following achievements:

- Preparation of practical and theoretical teachers' manuals for the first and second years of the Pre-school cycle.
- Completion of developing new textbooks for the basic cycle in line with the Educational Reform Plan (Classes 1-10).
- Completion of developing teachers' manuals for all classes of the basic cycle.
- Applying the new textbooks in the basic cycle.
- Development of new textbooks for the secondary cycle.

- Development of new textbooks for the vocational secondary education cycle. (MOE, 1995 b).

Within the development plan of curricula and textbooks focus was put on improving the content with the aim of developing creative thinking and promoting academic, vocational and applied educational tracks, whereby coordination is guaranteed. The plan focuses on developing skills for analyzing and processing information.

Alongside this the first National Conference of Educational development in Jordan considered the process of improving curricula as the first priority for educational development, with the fifth and seventh recommendations of the conference focusing on improving mathematics curricula by integrating them coherently with those of the elementary stage and taking into consideration the needs and capabilities of the students. The conference also recommended that more concern should be given to the following key elements:

- Basic mathematical skills and their relevance in the real world
- Trigonometry laws
- Spatial geometry
- Solving equations
- Improving the students' ability in problem- solving
- Reducing abstract concepts related to functions and relations, mathematical systems and groups a minimum
- An additional class for grades 5 through to 12 (Jaradat, et al, 1988).

In 1998, environmental education was integrated into the efforts of Improving Teacher Education at Jordanian Universities (ITEJU). The project was funded by the Jordanian Government and the European Union and organized through the services of the National Center for Human Resources Development (NCHRD) and the German Society for Technical Team Work (Gesellschaft für Technische Zusammenarbeit (GTZ)). The ITEJU brought a sizeable number of experts from abroad to the four participating universities (The University of Jordan/Amman, Hashemite University/Az Zarqa, Mu'tah University/Al Karak, Yarmouk University/Irbid), each representing various disciplines and specialties. The experts of Mathematics Education were Prof.Dr.A.Abele(Heidelberg) and Prof.Dr. L.Profke (Giessen) and the expert for Teaching Practice at schools was Prof.Dr.H.Hörner (Heidelberg).

While that, an exchange was phased out in 2001; the project has contributed to a change of structure in teacher education. The project's focus was the link between theory and practice, crucial for the success of teacher education in each cultural setting, dsand, indeed, a point of constant challenge to teacher education worldwide. At Jordanian universities, a group of supervisors was established through ITEJU to provide a link and a means of connecting the theoretical part of teacher education as represented by university courses with the practice teaching in schools. These supervisors helped facilitate the integration of both aspects in accordance with circumstances, providing easy access to a range of laboratory schools for the theoretician and making practical teaching a securely established element of teacher education at Jordanian universities. Within that context, the environmental concerns were one section of the discourse (Hörner, et al, 2000) ; (Al Shannag and Schreier, 2001 [7]).

[7] *See available in: www.nchrd.gov.jo/devprojects*