

Chapter Five

Discussion of Results

This chapter discusses the results of the study, looks at the aims of the study and investigates the characteristics and reasons behind the development of the mathematics curriculum witnessed, in Jordan during the period 1964-1999.

The discussion of the results will also be displayed in three sub-periods according to the study questions and in light of the analysis of the MOE documents and interview opinions, which were presented in chapter four.

5.1 The First Question

What developments have the learning objectives of mathematics curricula in Jordan witnessed during the period 1964-1999?

The Ministry of Education before this period relied on teaching mathematics using the Egyptian curriculum and textbooks, particularly at the secondary stage. Those textbooks continued to be used until to the 1960s. After that, Jordan has made important changes to the mathematics curriculum for the secondary stage according to the UNESCO project of developing mathematics teaching in the Arab world.

According to analysis results in chapter four the Ministry of Education (MOE) mathematics documents and instructional plans indicated the subjects which were represented, for example teaching arithmetic for students of elementary stage and the subjects arithmetic, algebra and geometry for preparatory stage, whereas the subjects for secondary stage were represented by algebra, arithmetic, geometry, trigonometric and mechanics.

5.1.1 The Development of learning objectives during the Period 1964-1972.

According to the analysis of the document during the period 1964-1972, the most significant development witnessed by the curricula was the introduction of a mathematics curriculum documents produced by the Ministry of Education for each different educational stage. This included general objectives for teaching mathematics (see appendix 2), the number of weekly periods, content of the material (see chapter 1) and general directives for the techniques and methods of teaching and evaluation.

The reason behind the issuance of such documents was that since the beginning of education in Jordan and up until 1964 there had not been any indication of what could be called “philosophy of education”. Moreover, during the period of the British colonial rule, education objectives had been curtailed due to the policy of seconding employees and personnel to assist the colonial administration in running the country. (AL-Amayrah, 1999).

The interview with Dr. Al massray (see appendix:9) also indicated the reason behind the development was the Education Law No. 16 in 1964 which had a great effect in identifying the philosophy of education in Jordan for the first time, in light of the development of the prevailing political, economical and social circumstances. The MOE documents identified the objectives of education on which the curricula were based. The content of the curricula was changed and developed in the middle of 1965 in accordance to the specifications identified by the Education Law, in relation to objectives, weekly lessons, content of the material and teaching and evaluation techniques.

According to the analysis of the MOE documents and interview responses, it was noticed that the teaching objectives which were included in the curriculum documents for the education stages were characterized by ambiguity and lack of clarity for both the teacher and the learner. They focused on the cognitive domain and did not including any special objectives in the teaching of mathematics within each grade. This can be put down to the relative inexperience in such an undertaking for the staff of the curricula and textbooks which were established by the Education Law. The most significant function of this section was the drafting of guidelines and curricula for the different grades of the education stages (compulsory and secondary).

Furthermore, it can be said that the objectives of mathematics teaching in Jordan were not in line with those in advanced countries. This is due to the following reasons: neglecting the applied side, weakness of correlation between the objectives in the compulsory and secondary stages and not observing individual differences between students. The concern in developing the curricula and the methods of teaching was restricted to adjusting the number of lessons and reorganizing the content. The development process did not revise the objectives with regard to the lack of a correlated and practical educational policy which conformed with specialized studies. It engaged with the political authority in facing the tremendous increase in numbers of students due to the new interest in education, which led to an increased burden on the Ministry. The government focused on providing school buildings and teachers and therefore neglected many of the educational reforms relating to developing the objectives and curricula.

In addition to this was the role played by the political, economical and social circumstances which prevailed in Jordan after the war in June 1967 and the political and economical instability which happened as a result. The influx in people to Jordan as a result of the Israeli occupation of the West Bank (Palestine), resulted in Jordanian cities suffering from overcrowding, increased pressure on schools, overcrowded classrooms and the occurrence of radical changes in the social and educational structure due to the interaction between the people Jordan and Palestine. The reasons for the lack of correlation between the objectives in the secondary stage with those of the other stages, is attributable to the way in which the curricula were drafted. Since the school textbooks were drafted, prepared and compiled, certain modern concepts such as the theory of sets and the theory of probability were introduced, as a result of Jordan's participation in the mathematics teaching development project in the Arab world.

This project had been supervised by the UNESCO since 1968 and focused on introducing modern mathematics to school curricula starting from the secondary stage and subsequently to the preparatory and elementary stages. This was introduced through the formation of the Jordanian National Team to develop mathematics teaching, a team of experts in mathematics and education from Jordan University and the Ministry of Education. It combined certain modern trends and classical curricula to form an interim phase, after which it was possible to change and modernize the curricula with regard material and technique (The Ministry of

Education, 1971). Due to the efforts of the Ministry of Education during this period, mathematics teachers received training to make them familiar with teaching mathematics according to the new content of the curriculum.

Despite the efforts to improve and develop the curricula in Jordan during the period (1964-1972), the UNESCO report which was submitted in the working seminar held in Beirut in 1969 indicated that the curricula still tend allot less time to mathematics, science and practical activities than is the world trends, that the orientation of the curriculum continues to be towards success in examinations with traditional methods such as memorization and rote learning emphasized and that few teachers seek to adapt the curriculum to local conditions. Hence despite attempts to rationalize and strengthen primary education through curricula changes the spirit in thousand of class rooms remains highly scholastic and almost no attempts are made to excite the imagination and curiosity of the students or to develop their creativity, resourcefulness and independence (AL-Tall, 1978).

5.1.2 The Development of learning objectives during the Period 1972-1987.

As for the development of objectives of teaching mathematics included in the curricula during the period 1972-1987, these showed the positive effect of political stability in Jordan. The development plans were drafted in order to face the problems encountered by the educational system in Jordan, such as the increase in population and students, achieving democracy in education for all groups in society. The validity of the curricula were not suitable for conveying the scientific and technological advancement, the modification of educational legislation relating to the development of the curricula, objectives and methods of teaching mathematics; and the educational conferences which had been held during this period.

Therefore, during the period 1972-1987 the Ministry carried out a review and reform process in the educational system. This process included developing and changing the curricula for all of the educational stages, reforming and identifying the philosophy of education in Jordan and identifying the general objectives of education and the special objectives for each one of the different stages.

In order to implement the development plan to solve the problems, the Ministry designed the first procedural program for curricula development and the second for developing textbooks and drafted comprehensive specifications for these programs.

These specifications included the reality of current practices, the background of the problem, justifications for development, procedural lines required for achieving the objectives and the timetable proposed to carry out the plan.

The weakness of correlation between the objectives of the curricula for the elementary stage grades (1-6) and the objectives of the curricula for the preparatory and secondary stages (7-12) is ascribed to the way in which these curricula have been designed. The curricula for the elementary grades was designed in coordination with the curricula and textbooks of Jordan and Syria in 1975, with the aim of developing the educational process in the two countries. They benefited from experiences of other countries as well as from educational achievements and innovations, especially in the fields of science and technology. In addition to this, the aim was to achieve comprehensive cultural and intellectual unity between the two countries by unifying the curricula.

A joint technical committee designed a shared learning plan and prepared unified curricula for the Elementary grades of which the Council of Education in Jordan approved and decided to start implementing in the school year 1977/1978.

The unit method was used in designing the curriculum which was established on integration between the different aspects of the material in the one cognitive domain through identifying the objectives of the educational stage, then identifying the objectives of each educational stage grade, identifying the objectives of each unit within each grade. The committee decided the fundamental concepts in the curriculum and the fundamental skills that it shares with other curricula, as well as its fundamental skills in accordance with a grading and sequence map for these concepts and skills (Hiyasat et al, 1990).

The document for the mathematics curriculum for the preparatory stage (7-9) and the secondary stage (10-12) was designed by the Jordanian National Team of Mathematics Development in light of the modern vision and prevailing trends of mathematics teaching. Thus the nature of mathematics is seen as an associated and integrated structure within the frame of a pioneering project to developing mathematics teaching in the Arab world under the supervision of the Arab Educational, Scientific and Cultural Organization. The aim was to complete the UNESCO project to develop mathematics curricula in Arab countries, to reform them and to make them more suitable to the available capabilities (Al-Mussaddeq, 1985).

5.1.3 The Development of learning objectives during the Period 1987-1999.

The curricula and objectives of teaching mathematics during the period 1987-1999 witnessed both change and development, because of the change in the education structure which included increasing the compulsory stage from 9 years to 10 years. The curricula document for the Basic stage (1-10) identified the main objectives for each grade, then identified the mathematical content for each grade according to the objectives. The objectives also included identifying the basic concepts and skills in accordance with the three cognitive domains (mental, emotional and skills). This development can be ascribed to the experience of the members of the National Team for the Development of Mathematics Curricula in Jordan throughout the last two decades.

The reasons behind the development of the curricula during the period 1987-1999 were due to the recommendations of the Educational Development Conference which was held in Amman on 7th and 8th September 1987. This Conference extended the Basic Compulsory stage to ten years instead of nine. Additionally, the results of the study carried out by the Ministry with the aim of evaluating the reality of the mathematics curriculum, showed that the aims did not sufficiently concentrate on developing students' abilities in problem solving, higher mental skills, basic skills and the linking of them to daily life. Also they showed that the number of lessons assigned to the mathematics curriculum was insufficient, with fewer lessons but the same number of topics. The results also showed a strong focus on modern concepts including functions, number systems and groups (JNTIM¹, 1987).

During the second half of the twentieth century higher education in Jordan started to distinguish its policy and teaching training colleges were established in order to meet the great need for teachers which resulted from the peoples' tendency to register in compulsory and secondary stages. Those colleges and institutions aimed at preparing teachers to teach in compulsory stage. The period of preparation in these colleges was two years and the programs included general education and specialized education (Obidat et al, 1993).

¹ - Jordanian national Team for Improving Mathematics Curricula

The statistics indicated that 1011 students enrolled colleges of education in 1962/1963 and this rose to 8621 students in 1979/1980, then to 31976 students in 1992/1993. However, it went down to 26942 students in 1998/1999, as a result of the growth of public and private universities in Jordan.

Education in Jordan suffered from a sharp lack of qualified teachers due to the rapid increase in the number of students. As a result of this, the Ministry of Education depended on teachers from the neighboring countries to teach mathematics. Although the Ministry of Education statistics indicted that the qualifications of these teachers did not reach the lower level identified by the Education Law No. 16 (first certificate of University, B.C), the percentage of teachers who were under qualified was 32% for the compulsory stage and 92% for secondary stage. During the 1980s in an attempt to reduce the problem of under qualified teachers the Ministry of Education cooperated with government universities (Jordanian and Yarmouk) and sent 486 students every year, to study 1st University Degrees in Mathematics and 460 teachers in courses in methods of teaching mathematics through the 1st University Degree and Diploma and the M.A.Degree (Jaradat, e tal, 1980; AL-Tall, 1979).

Before the establishment of the University of Jordan in 1962 students who were able to continue their higher education had to leave the country and go to the arab and foreign universities. Later six public and thirteen (13) private universities were established. Accordingly, 16949 students who enrolled for B.C degrees in 1988 and 6143 students who enrolled for higher education on higher diploma, M. A and Ph.D. programs.

Summary and Conclusion

It was noticed that the general aims of teaching mathematics during the period 1964-1972 were characterized by ambiguity for both the learner and the teacher. This ambiguity was due to the fact that the mathematics curricula documents did not contain special objectives for each mathematical topic and educational grade. Moreover, they concentrated on the cognitive domain and were concerned with lower thinking skills such as memorization, recalling and recognizing facts and concepts. They were also limited to developing higher mental skills by proving geometric facts and relationships.

Furthermore, it was noticed that the aims of the mathematics curricula during the period 1972-1987 lacked in identifying and demonstrating the three domains of cognition, mental, affective and psychometric. The curriculum documents also contained the special objectives for each of the school grades and for each of the units in the curriculum, as well as the logical and psychological organization. Additionally, the aims incorporated modern developments in the fields of teaching mathematics through concentrating on mathematical structures and utilization of statistical techniques when representing data. However they did not focus on linking mathematics with every day life through mathematical applications nor on developing higher mental skills through linking special objectives with the units in the different grade curricula.

As for the period 1987-1999, the general and special aims for teaching mathematics are clear and are specified for each educational stage and for each grade within the stage. They also took into consideration the three domains of cognition (mental, affective and psychometric) and concentrated on developing thinking skills, mathematical communication skills, and problem solving skills. Furthermore, the special objectives of the units were characterized by their clarity, assessment and continuity with the aims of the secondary stage. However, the general and special aims for the secondary stage were not as clear and detailed as those for the Basic stage.

Summary: the table below is a summary describing the developments of learning objectives of the mathematics curricula in Jordan during the period 1964 – 1999. These developments are displayed according to three sub-periods.

The first period (1964-1972)	The second period (1972-1987)	The third period (1987-1999)
<ul style="list-style-type: none"> - Learning objectives were ambiguous for teachers and students across all educational stages. - There was focus on the cognitive domain, - The affective and psychomotor were ignored. - There was a lack of connection between learning objectives of educational stages. - There was focus on memorizing facts, concepts and mastering the arithmetic skills. - There was a lack of connection linking between learning objectives throughout grades. 	<ul style="list-style-type: none"> - The aims were stated more clearly Special behavioral objectives related to the topics were included. - It took into consideration cognitive , affective and psychometric domains. - It included integration between branches of mathematics. - There was focus on understanding the mathematical structure. - There was a lack in the linking of learning objectives of the educational stages. - The time allocated to achieve the learning objectives was insufficient. 	<ul style="list-style-type: none"> - The general and special behavioral objectives were more detailed and clear. - It took into consideration the cognition, affective and psychometric domains. - It focused on developing skills of logical thinking, communication and problem solving - It linked the mathematical topics by a map of concepts and skills. - There was a lack in the linking of the learning objectives of mathematics in some of the grades. - The time allocated for some grades was insufficient.

5.2 The Second Question:

What developments have the mathematical content of mathematics curricula in Jordan witnessed during the period 1964-1999?

During this period the curricula of school mathematics in Jordan underwent three phases in which the content witnessed change and development. To achieve the objectives of the study and to answer the above question, the characteristics and justifications of the developments were investigated according to:

5.2.1 The development of the mathematical content during 1964-1972.

The modernization and change in content for the grades 1-9 during this period, were the result of a set of justifications represented by the introduction of the Education Law No. 16 in the year 1964 and the modification of the educational scale so that the period of compulsory education became nine years. The revised content for the grades 7-9 focused on concepts and skills in arithmetic and teaching algebra and geometry for the first time. This is because one of the objectives of teaching mathematics, from the point of view of curricula developers, is to provide students with real life situations as a strong basis for the secondary stage which is where many students end their education at the compulsory stage (1-9) (MOE, 1965).

In light of the results from the analysis process of the MOE document, the content of the mathematics curricula for grades 1-4 during this period showed the following characteristics: focus on arithmetic skills, familiarization of measurement systems and the relationships between them, while not focusing sufficiently on geometric concepts and skills and on the applied side of mathematical knowledge. Also, the content of the curricula documents did not include teaching concepts and skills according to the number theory, statistics and probability.

As for the characteristics of the mathematics curricula for the fifth to the ninth grades, these were represented by focusing on studying concepts and skills through the branches of mathematics: arithmetic, geometry and algebra. Focus was directed on the logical organization of mathematical topics in content- building.

The method of content presentation was not conducive to students' growth and mental development. Furthermore, the content did not concentrate sufficiently on

developing mental skills, the scientific method of thinking, or mathematical applications; there was also a lack of correlation between the topics of mathematics branches. Moreover, the technique used in presenting the curricula did not encourage students to react with it; neither did it include concepts and skills in accordance with the Data Analysis and Probability Standard.

The analysis of interview responses of the decision makers and experts (see appendix:9) indicates that the reason behind the modernization and change to the content for the secondary stage (10-12) was Jordan's participation in the project to change the content of mathematics curricula in the Arab World under the supervision of UNESCO. Therefore, the Jordanian National Team for the Development of Teaching Mathematics ruled that the content for the secondary grades should combine modern trends. A classical curriculum was to be a transitional stage after which curricula would use modernized material and techniques. The subsequently revised curricula for the grades 10-12 brought about logical organization in content presentation; there was focus on the modernization of the basic skills and modern topics such as sets, relationships, functions, descriptive statistics and probability were also introduced. However, the content was overcrowded with mathematical topics disproportionate to the number of lessons allocated to teaching mathematics for each grade. Correlation between mathematical topics throughout the grades was not observed because the topics comprising the mathematics curriculum took the form of separate subjects.

5.2.2 *The Development of the mathematical Content during 1972-1987*

From the analysis of the mathematics curriculum, we can see that the content for the grades 1-6 witnessed a change by way of the introduction Number and operations using concrete objects and the concept of set and function. Examples include the interpretation of the addition operation through the union operation and the balance between elements of two sets when using the connection style one to one correspondence. The content also included concepts and skills in measurement, fractions and operations, characteristics of geometric figures with two or three dimensions, areas and volume, the principles of the Number theory and rounding-off and estimation of numbers.

It did not however include the study of concepts and skills in accordance with the Data Analysis and Probability Standard. The method of presenting the curriculum content of mathematics for grades 1-3 can be described as suitable to the pupils' age and cognitive development. It is in accordance with the new vision of the mathematics curricula, despite however not observing the balance between some concepts and skills according to certain content standards.

The content for the grades 4-6 was overcrowded with concepts such as arithmetic and geometry which was of proportion to the allocated number of lessons. It therefore did not focus sufficiently on the applications of mathematics in every day life. The reason for this could be due to the method by which the curriculum for the grades of the elementary stage was compiled according to the curricula and textbook unification plan between Syria and Jordan.

The curricula were compiled as a temporary solution between the two countries, and were implemented in the school year 1976-1977 despite the difference between the educational systems in the two countries. The compulsory stage in the Syrian system ended with the sixth grade while in Jordan it ended with the third preparatory grade (9th) (Khasawneh, 1985).

Among the most significant changes of content for the preparatory and secondary stages (grades 7-12) was preparation the curriculum and mathematics textbooks for the preparatory stage (grades 7-9) and the secondary stage (grades: 10-12) in cooperation with the Arab Educational Scientific and Cultural Organization.

The revised content was in harmony with the new vision of the mathematics curricula because it included certain new concepts which were to be introduced in the secondary stage such as sets, relationships, functions and statistics principles. It also concentrated on mathematical structures. The organization of the content took into consideration the need for scope and sequences by distributing the content over ten fundamental concepts. Moreover, the spiral method was used in constructing the content to achieve a comprehensive representation of mathematical knowledge and on introduction of concepts and fundamental cores throughout the grades with increasing levels of depth and detail. The content however lacked integration within individual grades and throughout the different grades. This was due to the weakness

of correlation between the concepts on which the content was based. The content was characterized by abstract focus on arithmetic, geometry. However there was insufficient use of algebraic applications because the content reflected the nature and language of mathematics as an organized structure of knowledge with its own concepts and ways of thinking. It was also noticed that the mathematical content of the curricula was overcrowded with mathematical topics disproportionate to the number of lessons allocated in the prescribed teaching plan.

As for the reasons behind the development of the curricula during this period, some were associated with the methodology adopted by the Ministry to develop the educational process, improve educational facilities and achieve democracy in education by giving all groups in society the opportunity of education.

The development of school curricula is considered one of the fundamental cores of the modification and educational development process. Also, the development witnessed by the mathematics teaching curricula through the unification of the different branches of mathematics indicates the modern vision of mathematics as an integrated whole whose links between its parts are strong and interrelated with each other (Hiyasat et al, 1990).

This is in addition to incorporating the mathematics teaching development project for the grades of the preparatory stage (7-9) within the projects of the Arab Educational Scientific and Cultural Organization as a completion of the UNESCO project to develop teaching mathematics in the Arab world (AL-Mussaddeq, 1985) and as an evaluation of the Ministry curricula by the Education Policy Committee of Jordan in 1979. This evaluation also revealed a lack of correlation between the special educational objectives of each of the educational stages and the curricula. It also revealed that the curricula did not keep up with accelerated cognitive and technological knowledge. The curricula were also criticized for their concentration on listing facts and information, ignoring skills and not observing students' capabilities and psychological needs in the teaching and learning process (MOE, 1979¹)

¹ - The Ministry of Education. 1979. The Report of the Education Policy Committee in Jordan, page 79-80.

5.2.3 The Development of Mathematical content during the Period 1987-1999.

The development and modernization of the curriculum during the period 1987-1999 was considered a top priority for educational development. The Ministry of Education realized the importance of curricula, with it being among the most significant elements of the educational process. Educational curricula are important in their role of shaping the character of citizens, having a balanced structure to meet the personal and social needs of the learner and to keep up with the social, economic, practical and technological changes in a rapidly developing society.

The seventh recommendation included the development of mathematics teaching through focusing on the basic skills and linking them with reality, increasing attention to students' ability to solve mathematical problems, concentrating on the trigonometric laws, space geometry, problem solving, decreasing the abstract meanings related to functions, relationships between mathematical systems, numeration and series systems and allotting an additional lesson for each of the grades (MOE , 1988).

Among the prominent characteristics of the mathematics curriculum for the first to the fifth grades of the Basic Stage were the succession and sequence in distributing the mathematical topics in harmony with the content standards, including: the analysis form of numbers and operations, measurement, Number theory and geometry, excluding the Data Analysis and Probability standards. The content was in harmony with the new mathematics curricula; it organized the mathematical knowledge in a way that suits the level of students' development and mental capabilities.

Tackling mathematical problems through solving open sentences and daily applications was also included in the content. Furthermore, the curriculum document included an organizational framework which demonstrated succession, sequence and grading of the substance of the curriculum content and the correlation of the mathematical topics with each other throughout the grades of the Basic Stage.

The curriculum content for grades 6-10 was characterized by tackling modern topics in accordance with the Data Analysis and Probability standard. Succession and depth in statistics concepts and skills are observed through both the sixth and seventh grades, whereas the content for the eighth grade did not include statistics concepts and skills, in accordance to the Data Analysis and Probability Standard.

This can be ascribed to the view of the committee who drafted the curricula because they considered statistics and probability to be one standard. The content however did include the introduction of concepts and skills according to the algebra standard, grading though out the grades. Furthermore, the content focused on solving applied problem, whereas the content of the curriculum for grades 11 and 12 were characterized by the reduction of mathematical structures. The curriculum document also included the identification of the mathematical content for each of the secondary stage grades (11 and 12) through the detailed unit content of the grade curricula. However, there was a weakness in the correlation between the topics included in the curriculum content in relation to the analysis standards and through out the grades.

Moreover, the content was overcrowded with mathematical topics disproportion to the number of lessons outlined in the teaching plan. The content of the curriculum document also did not include a table to demonstrate the gradation and sequence of the concepts and skills through the topics of the curriculum for each grade. A possibly reason for this could be that different committees drafted each document and there was lack of communication between the committee that drafted the mathematics curriculum for the Basic Stage and that which drafted the secondary stage curriculum.

Summary:

The table below is a summary describing the developments of the mathematical content of mathematics curriculum in Jordan during the period 1964–1999. These developments are displayed in three sub-periods as follows:

The first period (1964-1972)	The second period (1972-1987)	The third period (1987-1999)
<ul style="list-style-type: none">- The content consisted of separate branches such as: arithmetic, algebra, geometry etc.- It did not include a map to explain the organization and scope and sequence of concepts- It did not concentrate on the applied side or problems solving.- The content design did not take into consideration the students' needs and capabilities.- It did not introduce any concepts or skills for teaching through the statistics and probability standards.- It used the logical organization in presenting the topics of content.- There was lack of sequence and cohesion among the content of the educational stages.	<ul style="list-style-type: none">- The content unified the different branches of Mathematics.- It included on a map to explain the organization and scope and sequence of concepts among the grades.- The content plentiful with topics and focused on teaching the modern concepts(abstractness).- The presentation of some textbooks content comes to appropriate the teachers level.- The content does not include the teaching of basic concepts of probability and statistics to grades 1-8.- It uses the spiral method to present the topics.- There was lack of sequence and cohesion among topics of the content for some classes and educational stages.	<ul style="list-style-type: none">- The level of abstract concepts was decreased and the number of periods specified for teaching was increased.- It included a map to explain the organization and scope and sequence of concepts among the grades.- It decreased the level of abstractness and focused more on problem solving- The content was designed around and took into consideration the students' needs and capabilities.- The content did not focus on teaching certain fundamental concepts of probability and statistics to grades 1-5.- It used the spiral method to organize the mathematical content- There was lack of sequence and cohesion among some standards of the content.

5.3 The third Question

What developments have the instruction methods of mathematics curricula in Jordan witnessed during the period 1964-1999?

Teaching methods and educational activities are considered to be fundamental components of teaching mathematics and the main medium in the interpretation of educational objectives. They represent the techniques of transmitting knowledge and the mathematical content of the curriculum to learners.

5.3.1 The Development of instructional methods during the period 1964-1972.

The mathematics curriculum document for the compulsory stage (grades 1-9) during the period 1964-1972 was analyzed and the result of this analysis indicated that the curriculum did not include a clarification of the teaching methods for teaching the different areas of the mathematics curriculum, for example, arithmetic, geometry and algebra. The focus of the curriculum was directed to the teaching material used in each of these areas.

Consequently the mathematics curriculum document for the secondary stage (grades 10-12) did not include any indication or information relating to teaching techniques or general directives. The textbook represented the main source of knowledge for both the teacher and learner.

Additionally, the objectives of teaching mathematics focused on training students to master arithmetic operations and skills by memorizing them. Therefore, the method used by teachers was based on inculcation and personal skills which mainly focuses on memorizing and recalling facts. The traditional methods were also used by teachers to teach mathematics. However, they didn't focus on developing critical thinking when using modern scientific techniques to investigate and solve problems.

the analysis of the interview responses (see appendix:9) about the reason for the unsatisfactory methods used in teaching mathematics outline the possible reasons as follows: the political motivations behind the random expansion in the number

schools because the government was issuing orders to open schools without previous thought of expanding educational policy. It also did not provide efficient teachers to work in these schools and assigned teachers holding only a general secondary certificate and who were therefore unfamiliar to the pedagogy.

Moreover, the weakness of the curricula in exhibiting general and special teaching techniques, accompanying activities and educational media focusing on and memorizing facts and recalling them rather than focusing on the development of higher mental skills, the scientific technique of thinking and problem solving were among the main points contained in the UNESCO Education Report submitted in the seminar held in Beirut in 1969 about the characteristics of mathematics and science curricula (AL-Tall, 1978).

5.3.2 The Development of instructional methods during the 1972-1987.

The development and modernization of mathematics curricula conducted by the Ministry during the period 1972-1987 for all educational stages did not include identifying the techniques and activities for teaching the topics of the mathematical content or for the units included in the curriculum of each grade. However, it did include certain views and general principles relating to classroom practices, such as individual difference, grading in education, establishing concept and relationships, learning by directed discovery and demonstrating the importance of these techniques without identifying the topic or the level of the grade which that technique is suited to.

Among the prominent characteristics of the developments witnessed during this period was the implementation of the mathematics teaching curricula development project for Jordan in the secondary stage. This was part of the pioneer project supervised by UNESCO Education in the Arab Countries. This project was followed by the AESCO project which developed mathematics teaching in the preparatory stage, in addition to the education reform and development process. It featured concern with the learner and gave the learner the opportunity to interact purposefully with the curriculum with teachers' assistance.

This interaction required linking the experiences contained in the curricula with every day life. Additionally, the curricula were influenced by the findings of

educational research and studies and mathematics teaching was reorganized in light of the intellectual development of the learner and the logical organization of the material in a form which graded topics in relation to depth, comprehensiveness and innovation in stages and levels that were suitable to students' mental maturity level. Textbooks were prepared and compiled using the spiral method and learning was implemented by the discovery technique throughout the preparatory and secondary stages textbooks.

Despite the drawbacks of familiarization with the content by using the discovery method and not taking students' capabilities to interact with the content into consideration, it was considered an educational innovation in line with the developments witnessed by the curricula and mathematics teaching techniques in advanced countries. The change witnessed to mathematics curricula in Jordan during this period came about through participation in the mathematics teaching development project in Arab countries under the supervision of UNESCO, combined with the lack of experiences and training of the technical committees in Jordan, in preparing and compiling curricula and textbooks.

Due to the low level of teacher preparation the Ministry of Education became concerned with improving the educational supervision apparatus in order to facilitate the teacher's job technically and professionally. It provided the teachers with prepared lessons and educational materials suitable for practical application. The aim was to improve the teachers' performance and to qualify the teachers of the compulsory stage who only held general secondary certificates. These teachers were encouraged to obtain teaching diplomas and exchange programs were organized with different specializations to meet the Ministry's needs.

In order to meet these needs throughout the educational stages the Ministry of Education organized training and updated courses for qualified teachers in the Preparatory and Secondary Stages, who had already taught for four years. This was in cooperation with the Jordan and Yarmouk universities. Teachers who held diplomas from colleges were also given the opportunity to study courses with university undergraduates in subjects and topics relating to their specialization (Jaradat and Abed Al-Hamid, 1980).

5.3.3 The Development of instructional methods during the period 1987-1999.

The process of modernizing and updating the curricula for all grades of the educational stages emanated from the recommendations of the Educational Development Conference which was held during 1987-1999 and focused on the basic skills and linking them to reality and was concerned with developing students' capabilities to solve mathematical problems (MOE, 1988, p 75).

The fifth Guideline of the mathematics curricula documents (Basic and Secondary) "Teaching Techniques, Educational Media and Activities" indicated a variety of educational techniques, media and activities suitable to achieve the objectives of teaching mathematics. This included developing thinking among students, using the directed discovery method in acquiring mathematical concepts and generalizations of curricula documents (MOE, 1991, 1993).

Although the curriculum did not provide a strategy which demonstrated how to teach the content in a way suited to student's abilities, the MOE started to compile and prepare guidelines for teachers which included a number of directives and guides to assist them in choosing educational techniques to suit each lesson and group of exercises.

During this period, the Ministry also worked on developing teacher training programs to improve efficiency in their performance through developing their experience and updating their techniques and skills, through coordination with Jordanian universities in designing teachers' preparation programs, and through benefiting from university research and studies which were designed to address certain educational issues.

Furthermore, the Ministry's interest in developing mathematics teaching methods and techniques was represented by its cooperation with higher education institutes and state universities. Supervisors were involved in training courses within mathematics teaching development projects such as the European Union project to develop mathematics teaching in Jordanian universities. The aim was to familiarize supervisors with the experiences and experiments of mathematics teaching methods

and techniques in advanced countries (i.e. thinking methods, problem-solving, mathematical connections, representation and mathematical associations).

This period was also characterized by the Ministry's concern with assisting the teacher to identify students' needs and to make organized decisions according to these needs. Therefore, in 1995 the General Directorate of Examinations carried out a project of diagnostic evaluation as a teaching-learning technique and educational supervisors were trained on this project. It also developed a special guide linked to this project for the Ministry, which was distributed to the teachers.

Moreover, this period was characterized by the use of effective teaching methods to meet students' needs and to provide them with knowledge in a way which developed their thinking through using investigation as a method of mathematics and adopting the scientific method in searching for the solution to a problem. Therefore, a guide for investigation in mathematics was prepared and both supervisors and teachers were trained on how to apply this technique in schools.

Summary:

The table below includes a summary, describing the characteristics of developments of instructional methods of mathematics curriculum in Jordan during the period (1964–1999) , and these developments displayed according to three sub-periods as follow:

The first period (1964-1972)	The second period (1972-1987)	The third period (1987-1999)
<ul style="list-style-type: none">- It focused on memorizing facts and proficient the mathematical skills.- It ignored the role of student participating on.- It included classical methods and did not focus on developing thinking skills.- There were few teacher training courses in the methods of teaching mathematics.- There was lack of academic preparation of teachers.- Methods of teaching focused on recalling relevant facts.	<ul style="list-style-type: none">- It did not focus on developing of thinking skills or problem solving.- The MOE became concerned with teachers preparation.- The MOE focused on preparing teachers academically to teach mathematics.- The MOE took into consideration the students' needs but the methods which were used by teachers were still traditional.	<ul style="list-style-type: none">- It focused on developing skills of thinking and problem solving- It focused on the role of student in participating.- Supervisors and teachers were academically prepared by the MOE.- Supervisors and teachers were trained on using methods of teaching such as: problems solving, investigating, brainstorming and methods of cooperative learning.- Methods of teaching focused on encouraging students to think, ask questions, solve problems, discuss their ideas and use strategies and solutions

5.4 The Fourth Question:

What developments have the evaluation methods of the mathematics curricula in Jordan witnessed during the period 1964-1999?

Evaluation is considered one of the vital points in assessing the extent of achievement among learners by revealing the points of strength and weakness in the content.

5.4.1 The Development of evaluation methods during the period 1964-1972.

The analysis of the interview responses of decision makers and experts (see appendix:9) indicated that the methods of evaluation and development of mathematics curricula at the 1960s were based on the remarks of mathematics teachers and supervisors. Moreover, student assessment were carried out by tests prepared by teachers and were focused on measuring the cognitive domain. Promotion from the compulsory stage to the more specialized secondary schools was controlled by a standardized written examination. The MOE produced a general exam for the end of the secondary stage and students could apply to university according to their results.

Therefore, the evaluation techniques used here focused on examinations to measure the first level of cognition, which included information memorization and recall of facts. The reason for this is ascribed to the Ministry's preoccupation during the period 1964-1972 on providing places in school for the increasing numbers of students this resulted in the focus being on quantity rather than quality in the educational process and the curricula was then focused on the cognitive domains. There was a shortage of teachers, therefore unqualified teachers were assigned and mathematics was taught by teachers who were not actually specialized in mathematics. Consequently, the UNESCO report submitted during the seminar held in Beirut in 1969, confirmed that the curricula were still directed towards passing examinations, were focused on classical techniques such as memorization and did not include any attempts to develop thinking (AL-Tall, 1987).

5.4.2 The Development of evaluation methods during the period 1982-1987.

Among the most significant characteristics of the period 1972-1987 was the development of and updating of the mathematics curricula in light of modern curricula trends and the objectives dealing with the cognitive domains. This was in addition to developing general and school examinations with the objective of assisting students in developing their abilities to think and create; focus on memorization and observe all levels of knowledge (cognition, understanding application, synthesis and evaluation). Among the significant characteristics and problems included in the economical and social development plan in Jordan during the period 1981-1985 was the dependence of the evaluation techniques on general and school examinations in measuring knowledge and understanding, instead of focusing on the balanced measurement of information, skills, higher mental capabilities and practical skills (Al-Amayreh, 1999, p 257). This was the result of teachers not being trained properly on how to draft questions within the examination specifications and not building a specifications table in which to combined the content and objectives levels.

5.4.3 The Development of evaluation methods during the period 1987-1999.

the significant characteristics of this period were the recommendations of the Educational Development Conference in school curricula and general examinations. these recommendations were implemented by the Ministry of Education and established an administration specializing in general examinations and provided it with specialized technical and administrative cadres. Furthermore, the Ministry worked on training all supervisors, teachers and school head teachers in constructing tests, developing guides for achievement tests to be distributed to other teachers and trained them how to use these guides.

Also among the significant features of the developments witnessed by the evaluation techniques, concerning the development of higher thinking skills, was a decision to set percentages for thinking levels to be included in the tests (25% for application and 15% for the higher thinking operations) for the Basic Stage (MOE, 1991).

The analysis of the interview response (see appendix:9) with respect to this subject indicated that the methods of evaluation were developed during the early 1990s and that the MOE trained teachers on methods of test construction, diagnostic evaluation, methods of developing thinking and investigation. The MOE prepared national examinations to measure the achievement and performance of students and presented the feedback of the analysis of the results of these examinations.

The MOE also participated in international tests to compare the performance level of students in Jordan with those in the other countries. The MOE presented the feedback to teachers aiming to improve the mathematics curriculum and the methods used to teach mathematics. The MOE still make one general examination at the end of secondary stage which prepared by specialized team in MOE and in light of the achievement average the students transferred to university.

Moreover, this period reflects the feedback of the International Study for Evaluating Educational Achievement (IEA) in cooperation with the National Center for Developing Human Resources in Jordan. The sample chosen from the eighth grade showed an obvious shortage in the answers on the mathematics and science test, when the test items were studied and students' responses were analyzed in accordance with the standards. The objective was to help teachers benefit from mistakes, show them how to achieve this through training workshops with groups of specialized people and supervisors and to enhance skills in both teaching and in setting examination questions, thereby improving students' level of learning.

the analysis results of Abu Zeinah study (2001) shows that 39% percentage of the final semester tests for grades six, seven and eight were prepared by forty-one teachers. They did not meet the relative importance of the topics within the content and the questions were only based on low level cognitive outcomes. Computation skills and knowledge had the highest percentage with (67.7%), the percentage for understanding was (29.3%) but the percentage for application and analysis was only (3%). The results indicated that the teachers had not follow the table of specifications when developing their tests. They had focused on essay questions rather than multiple choice in their tests.

Summary:

The table below includes a summary describing the developments of evaluation methods of the mathematics curriculum in Jordan during the period 1964–1999. These developments are displayed according to three sub-periods as follows:

The first period (1964-1972)	The second period (1972-1987)	The third period (1987-1999)
<ul style="list-style-type: none">- Assessment is not considered to be an integral part of classroom practice to enhance students learning.- A test is given to students at the end of a topic to see how students perform under exam conditions- The assessment methods did not take into consideration the student age, experience or special needs, which could affect the ability of a students	<ul style="list-style-type: none">- The MOE considered the students and considers as one of the main inputs of the educational process.- Assessment methods selected by teachers did not take into consideration the student age, experience or special needs, which could affect ability.- Teachers preparing tests for the preparatory stage were not always adequately qualified.	<ul style="list-style-type: none">- The MOE participated in the international study for evaluating eighth grade students- Teachers and supervisors trained on using and selecting assessment methods such as observations, conversations and interviews with students. They also were trained on how to prepare achievement and diagnostic tests.- The MOE took care when developing and preparing teachers and supervisors.

5.5 Conclusion and Recommendations

This study aimed to investigate the developments of teaching Mathematics in Jordan during the period 1964-1999. The study answered the following questions:

1. What developments have the learning objectives of the mathematics curricula in Jordan witnessed during the period 1964-1999?
2. What developments have the contents of the mathematics curricula in Jordan witnessed during the period 1964-1999?
3. What developments have the instruction methods of the mathematics curricula in Jordan witnessed during the period 1964-1999?
4. What developments have the evaluation methods of the mathematics curricula in Jordan witnessed during the period 1964-1999?

In light of the developments in teaching mathematics and for facilitating the process of investigating the characteristics and reasons behind these developments, the period 1964-1999 was divided into three partial periods. The first period was 1964 to 1972. The second period was 1972 to 1987 and the third period was 1987 to 1999.

The researcher has analysed the content of the documents of teaching Mathematics for all grades at each educational stage. The standard criteria of the content analysed through all three periods. Interviews were conducted with a sample of experts who had taught mathematics and witnessed the stages of the development during the whole period.

The interview was prepared to collect data and opinions to support the results of analysis the mathematics documents. In light of the results of the analysis, it was found that the curriculum of teaching mathematics in Jordan had witnessed a development in the domain of the objectives, content and methods of teaching and evaluation.

The following are the major developments that the mathematics curriculum witnessed during the period 1964-1999.

- **Mathematics Curriculum during the period 1964-1972.**

- Objectives were vague across the curriculum of the different educational stages.
- The objectives focused on cognitive aspects.
- There was a lack of connection in the objectives of each stage and among the different educational stages.
- The mathematical content of the curriculum was traditional and therefore focused on teaching topics separately such as algebra, geometry and arithmetic.
- Logical organization was used in presenting the mathematical topics of the content.
- There was a lack of sequence and cohesion in the mathematical topics of the curriculum within the various educational stages.
- There was a lack of academic preparation for teachers and an inadequacy of the training courses dealing with methods of teaching.
- students were discouraged to create, develop thinking skills and solve problems because of teachers' reliance on school textbooks and memorizing facts.
- Methods of evaluation were limited to achievement tests focusing on the lower level of the teaching objectives.

- **Mathematics Curriculum during the period 1972-1987.**

- Objectives became more clear and specific.
- Objectives included cognitive, affective and psychomotor domains.
- There was more emphasis on caring about the learners and considering them an important element of the educational process.
- The behavioural objectives of the content of the curriculum for each class of the different educational stages were identified through the teaching units included in the content for each class.
- Unifying the branches of Mathematics through the topics was included in the content of the curriculum.
- Objectives were abstract and this can be seen through the topics included in the curriculum.
- New topics were added such as relations, functions, correlation, mathematical structures and descriptive statistics.

- There was a lack of sequence and cohesion among topics of the curriculum's content for the different classes.
- The content of curriculum was disproportionate to the allocated time to teach it.
- The content included using lecture method in teaching mathematics, ignoring the development of thinking skills and problem solving and sticking completely to what school books included. The scientific and behavioural preparation of teachers was also ignored despite the use of the exploration method in presenting the content of the curriculum for the preparatory and secondary stages.
- The methods of evaluation were limited to achievement tests which only measured the lower level teaching objectives.
- Teachers neglected and not pursue homework and did not give immediate feedback for students' performances.

- **Mathematics Curriculum during the period 1987-1999.**
 - There was clear identification of the objectives of teaching mathematics.
 - The objectives included the three domains of knowledge (cognitive, emotional and psychomotor).
 - There was focus on the development of thinking and solving mathematical problems.
 - There was cohesion of the objectives within curriculum across the classes of the various educational stages.
 - The level of abstractness was decreased through the including of real life to mathematical applications on the curriculum's content.
 - The sequence of mathematical skills and concepts and using the spiral method in organizing the mathematical content was considered.
 - Some modern concepts such as descriptive statistics, probability, triangular rules, spatial geometry and solving equations were added.
 - There was focus on problem solving through the mathematical content of the curriculum.
 - Some topics of the secondary stage were included into the content for the basic stage.
 - The content of curriculum was disproportionate to the allocated time to teach it.

- In light of modernization and curriculum change, the methods of teaching have witnessed many developments. Teachers and supervisors were academically and behaviourally prepared and trained on various methods of teaching in order to achieve the objectives of the curriculum such as problem solving, development of thinking, cooperative learning, brainstorming...etc.
- The mathematical content of the curriculum of the various classes was constructed in light of the teaching units which included identifying the objectives, content topics, methods of teaching and evaluation and using the spiral method in presenting the content.
- Regarding evaluation, teachers were trained on preparing and constructing achievement tests where the focus was on the higher level of the teaching objectives.
- Teachers and supervisors were trained on diagnostic tests. They were supplied with models and plans were set for treating weak achievement. This was as a result of Jordan's participation in the international study, which saw changes on the eighth grade such as for treating weaknesses, improving the curriculum and methods of teaching.
- **Recommendations:**

In the light of the content analysis of the mathematics curriculum, the results of the study indicated the following Recommendations:

1. For Researchers:

1. Assessing the mathematics curriculum for Basic stage according to the standards which was published by NCTM, 2000.
2. Assessing the Mathematics curriculum for secondary stage according to the standards which was published by NCTM, 2000.
3. Assessing the Mathematics curriculum for secondary stage according to the implementation and including the content of the skills of thinking and problem solving.

2. For developing and curriculum constructions :

1. The content of schools curriculum must include concepts and topics according to the statistics and probability standards.
2. The schools program must prepare students to live in a world dominated by methods and products of science.
3. Using technology tools such as computer education and applications in teaching Mathematics (organizing and analysing the data, solving algebraic equations....).
4. Reducing some concepts and topics which included in the curriculum content of Teaching Mathematics for some grades, as well as, to make it suitable with the numbers of periods adopted by M.O.E.
5. Focusing on the language formulas according the textbooks writing related to the ability and students levels (readability of the textbooks).