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A Suggested Programme for Developing 4th Year Primary Pupils' Performance in Mathematical Word-Problems in Kuwait

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Meshal Al-mansouri

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ABSTRACT

The main objective of this study was to investigate the effect of using a suggested mathematical word-problem training programme on Primary 4 pupils' performance in mathematical word-problems. The study had a pre-post control group design. A treatment and a no-treatment group were exposed to pre-post methods of gathering data (a mathematical word-problem achievement test and a mathematical word-problem attitude scale). The treatment group was given direct and explicit training on how to solve mathematical word-problems, while the pupils of the no-treatment group received no such training; they were taught the same material they study at school. A "t" test was used to compare the means of scores of the control group pupils and those of the experimental group in the pre-post measurements. Results of the study revealed a significant improvement in the experimental group pupils' performance in mathematical word-problems because they had attended the suggested programme. Results also revealed that experimental group subjects' attitudes towards mathematical word-problems underwent an exceptional change because they had attended the suggested programme. Their attitudes towards mathematical word-problems became more positive than before. In the light of the results of the study, some recommendations were made for improving mathematics teacher training programmes, for mathematics teaching, and for further research.

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CHAPTER ONE
THE STUDY PROBLEM

Introduction and Background of the Study

From personal observation, as a teacher of mathematics in primary schools in Kuwait, and from nine years experience in marking primary school mathematics examination papers, I have noted that most, if not all, questions answered incorrectly, or simply left unanswered, by children come in the form of word-problems. This may be due to some well known difficulties experienced by pupils when working on mathematical word-problems, which include reading and understanding the content of the word-problem, converting the digits from verbal to symbolic forms, the appropriate choice of mathematical operation, and reaching the correct solution.

I wanted to check Kuwaiti Primary 4 pupils' performance in mathematical word-problems to see if that, too, is weak. I conducted a pilot study, a short mathematical word-problem diagnostic test for identifying pupils' difficulties with word-problems, and applied this to a group of twenty 4^{th} year primary school pupils in Kuwait (see appendix 2, p. 215). The results of this pilot study indicated that their performance in mathematical word-problems is, indeed, poor. They experience difficulty in one or more of the steps of solving a given word-problem i.e. reading and understanding the content of a word problem, converting the digits from verbal to symbolic states, selecting the appropriate mathematical operation and arriving at the correct solution to the given word-problem.

Actually, mathematics is seen to be one of the most important subjects taught in primary schools. In Kuwait, pupils learn mathematics for forty-five minutes of each of the five school days. It is one of the seven obligatory subjects taught in formal schools in Kuwait.

There is a common complaint among parents, educators, teachers and pupils themselves in primary schools in Kuwait that mathematics is a difficult subject to teach and to learn. In this respect, Mamdooh (2005) clearly confirms that learning and teaching mathematics are problematic in primary schools. He points out that pupils experience many difficulties, especially with mathematical word-problems. These difficulties include those already mentioned: reading the content of the word-problem, understanding its content, interpretation of digits from verbal to symbolic, selecting the appropriate mathematical operation, and arriving at the correct solution.

This is not just a problem for Kuwait. For example, highlighting the same problem, Ratanakul (1985) detects the same difficulties in mathematical instruction in Thailand, again related to language, and which include: the simultaneous use of both traditional Thai numerals and Hindu-Arabic numerals; misunderstanding of mathematics problems for cultural reasons; and/or difficulty in understanding the context of the problem. He adds that research has shown that primary and secondary school children have little difficulty with arithmetic concepts when problems are presented in number form but they do poorly on word-problems, indicating that abilities in concept formation in science and mathematics are related to language skills. Therefore, it is recommended that mathematics and languages are taught together and that they should not be taught in isolation.

Consequently, the present study derives first from my personal observations, second from the common complaints of parents, educators and teachers, third from the results of a pilot study, and fourth, from a study of relevant literature in the field of mathematics education.

Statement of the Problem

From what has been said above, my assertion here is that Kuwaiti Primary 4 pupils' performance in mathematical word-problems is weak due to their poor abilities in:

(i) Reading the content of mathematical word-problems
(ii) Understanding this content
(iii) Converting the digits from verbal to symbolic form
(iv) Making the appropriate choice of mathematical operation, and in
(v) Reaching the correct solution.

Therefore, the present study is an attempt to design and evaluate a programme that might intervene to help develop Primary 4 pupils' performance in mathematical word-problems, with particular reference to these five abilities, and to help change their attitudes towards mathematical word-problems.

The Study Questions

More specifically, the study attempts to answer the following questions:

(1) What are the difficulties experienced by 4^{th} year primary pupils in solving mathematical word-problems in Kuwait?
(2) What is the effect of an intervention programme on 4^{th} year primary school pupils' performance in mathematical word-problems?

This last question is further divided into five sub-questions:

(2.1) What is the effect of such a suggested programme on 4^{th} year primary school pupils' performance when reading the content of word-problems?
(2.2) What is the effect of the suggested programme on 4^{th} year primary school pupils' performance in terms of understanding the content of word-

problems?

(2.3) What is the effect of the suggested programme on 4th year primary school pupils' performance when converting the digits from verbal to symbolic forms in word-problems?

(2.4) What is the effect of the suggested programme on 4th year primary school pupils' performance when choosing the appropriate mathematical operations in solving word-problems?

(2.5) What is the effect of the suggested programme on 4th year primary school pupils' performance when arriving at the correct solution to word-problems?

(3) What is the effect of the suggested programme on 4th year primary school pupils' attitudes towards mathematical word-problems?

The Study Sample

The study sample comprises 100 4th year primary school pupils from two different schools; one for girls and the other for boys; fifty (50) pupils from Hisham Ibn Omayaa primary school for boys and the other fifty (50) from Lobaba Bint Al-haareth primary school for girls. They were assigned to four groups; two groups in each school, one of which was experimental and the other control. Fourth year pupils were preferred as participants in this study as the actual teaching and learning of mathematical word-problems starts at this stage; pupils in grades before the fourth year study just minor instances of word-problems. In addition, at this stage, pupils are mature enough to understand and interact with the teachers in learning word-problems as compared to younger pupils.

Experimental and control group subjects were the pupils of four classrooms intentionally selected from both schools. As indicated by their teachers from their classroom quizzes and as documented by their scores in the pre-test of the mathematical word-problem in this study, they were all average-ability pupils. In addition, they were approximately of very similar socio-cultural and economical background.

The chosen schools are considered two of the best schools in the state of Kuwait. They are located in the south of El-Sorra, in Hetteen district, and they are affiliated to the Governorate Educational Zone. They were chosen according to certain criteria, the most important of which are: (a) they are socially and geographically comparable and convenient; and (b), there are good relationships between myself and the administration of the two schools that have helped me whilst conducting this study. As is the case for all primary schools in the state of Kuwait, there are five educational stages in each school, from the first year to the fifth year primary.

Hisham Ibn Omayaa primary school for boys was established in 2003. There is one school director, two co-directors, and three social workers. In addition, there are sixty in-service teachers working in this school. There are also four classrooms at each educational stage; each one has between 23 and 26 pupils. The total number of pupils in this school is around five hundred (500); the vast majority of them are Kuwaitis and the others come from different Arabian countries, with their parents working in the state of Kuwait. The school building is considered one of the newest and cleanest buildings, and it is of a modern design. Classrooms are spacious and equipped with a variety of teaching aids such as whiteboards, blackboards, crayons, over-head projectors and some data projectors. These teaching aids are all paid for by the ministry of education in the state of Kuwait. Moreover, classrooms are air-conditioned as the state of Kuwait is considered one of the hottest of countries, especially during the summer season.

As for Lobaba Bint Al-haareth primary school for girls, it was established in 2002. The school building is also considered one of the newest and cleanest, both inside and outside, and its design is also modern. Its outside colour is rosy in colour to suite the common taste of Kuwaiti girls. There is one school director, two co-directors, and four social workers. In addition, there are sixty eight in-service teachers working in this school. There are four classrooms for the first year; five for the second year, another five for the third year, four for the fourth year, and five for the fifth year. Each classroom includes between 24 and 27 girls. The total number of girls in this school is around five hundred and fifty eight (558); the vast majority are Kuwaitis and the others come from different Arabian countries. Classrooms are also clean and spacious, air-conditioned, and they are equipped with good teaching aids, similar to those mentioned in the boys' school. These teaching aids, together with the study books, are all paid for by the ministry of education in the state of Kuwait.

Limitations of the Study

1. The study is limited to 4th year primary pupils in Kuwaiti schools where I live and work
2. Two schools are used in this study; one for girls and the other for boys
3. The sample for the study is limited to 100 Kuwaiti pupils from the chosen schools.

Objectives of the Study

The main objectives of this study are to:

(1) Identify particular difficulties experienced by 4th year primary pupils in solving mathematical word-problems

(2) Build and evaluate a programme that develops 4th year primary school pupils' performance in mathematical word-problems; to develop 4th year primary school pupils' abilities in reading the content of word-problems; understanding this content; converting the digits from verbal to symbolic form, the appropriate choice of the mathematical operations, and reaching correct solutions

(3) Identify 4th year primary school pupils' attitudes towards mathematical word-problems before and after applying and evaluating the suggested programme.

Therefore, the present study is an attempt to design and evaluate a programme that might help develop and enhance Primary 4 pupils' performance in mathematical word-problems.

Significance of the Study

The significance of the present study stems from the following considerations:

(1) The suggested programme is intended to help 4th year primary school pupils in Kuwait to become better able to solve mathematical word-problems

(2) This study is intended to focus teachers and curriculum developers, both in Kuwait and further afield, on the importance of the direct teaching of the skills and strategies suggested in the programme.

Instruments of the Study

Achieving the aims of the current study requires preparation of the following instruments:

(1) A 'Needs Assessment' Questionnaire

A needs assessment questionnaire has been prepared for assessing 4th year primary pupils' difficulties in solving mathematical word-problems from primary school mathematics teachers' points of view. Its intended purpose is to diagnose their needs for mathematical word-problem instruction.

(2) A Mathematical Word-problem Programme

A programme for developing 4th year primary school pupils has been designed. The programme design involved the following procedures:

(a) Design Procedures

(i) Building a list of word-problem performance difficulties through a review of pertinent literature and related studies

(ii) Judging the validity of the list by reference to a panel of mathematics experts in terms of:

- Importance
- Trainability or the possibility of training pupils in these difficulties

(iii) Stating general objectives and deriving behavioural objectives based on the general objectives

(iv) Judging the validity of the objectives by reference to a panel of mathematics experts

(v) Building the suggested programme

(vi) Evaluating the validity of the programme by reference to a panel of mathematics experts.

(3) Mathematical Word-problem Achievement Test

I prepared a pre-post mathematical word-problem test. The test consists of a group of word-problems aimed at measuring 4th year primary pupils' performance in mathematical word-problems. More specifically, the test aims to measure 4th year primary pupils' ability to:

(2.1) Read the content of the word-problems

(2.2) Understand the content of the word-problems

(2.3) Convert the digits in word-problems from verbal to symbolic forms

(2.4) Make an appropriate choice of mathematical operation

(2.5) Reach the correct solution.

(4) Mathematical Word-problem Attitude Scale

A mathematical word-problem attitude scale has been designed to identify 4th year primary school pupils' attitudes towards mathematical word-problems before and after studying the suggested programme.

The following table shows how the data will answer the research questions and what form of analysis will be used.

Table (1)

Questions of the Study	Hypotheses of the Study	Data to be Collected	Instruments Used	Form of Analysis Used
(1) What are the difficulties experienced by 4th year primary pupils in solving mathematical word-problems?		An assessment of the needs of 4th year primary pupils, the subjects of this study, for instruction and training in solving mathematical word-problems.	A needs assessment questionnaire that is administered to 4th year primary pupils' mathematics teachers, for eliciting information about the difficulties experienced by 4th year primary pupils in solving mathematical word-problems.	The questionnaire's results are statistically analyzed in terms of percentage. The validity will be judged by a panel of experts.
(2) What is the effect of the suggested programme on 4th year primary school pupils' performance in	(1) There is no statistically significant difference between the means of scores obtained by subjects of the	A measurement of 4th year primary school pupils' performance in solving mathematical word-problems	A pre-post mathematical word-problem achievement test that is administered to the subjects of	Results of the pre-post mathematical word-problem achievement test are statistically

mathematical word-problems?	control group and those of the experimental group in the pre-test for the mathematical word-problems. (2) There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-test for mathematical word-problems.	before and after teaching the suggested programme.	the study before and after the treatment, in order to measure the effectiveness of the suggested programme on the subjects' performance in solving word-problems.	analyzed by using a 't' test, in order to compare the differences between the mean scores of the study subjects in the pre and the post measurement of performance.
(3) What is the effect of the suggested programme on 4th year primary school pupils'	(3) 4th year primary pupils' post assessment mean-scores would be significantly higher than their pre-	A measurement of 4th year primary school pupils' attitudes towards mathematical word-problems	A pre-post mathematical word-problem attitude scale that is administered to	The scale's results are statistically analyzed by using a "t" test, in order to

attitudes towards mathematical word-problems?	assessment mean-scores on the mathematical word-problem attitude scale.	before and after teaching the suggested programme.	the subjects of the study before and after the treatment, in order to measure their attitudes towards mathematical word-problems before and after attending the suggested programme.	compare the differences between the mean scores of the study subjects in the pre and the post measurement of their attitudes.

The experimental Design

The study uses a quasi-experimental design, using an experimental group and a control group. One hundred 4th year primary school pupils from the two different schools, one for girls and the other for boys as described above, were assigned to four groups. There were two groups in each school, one experimental and one control. Subjects of the experimental groups were taught the suggested programme, not their usual curriculum, whereas, subjects of the control groups received no such special teaching; they were taught the same material they would normally study at school. Teachers involved in the teaching of all groups had the same qualifications. All were graduates of mathematics teaching departments at faculties of education in Kuwait and had approximately the same experience of teaching mathematics to primary school children.

Hypotheses of the Study

In this study, it is hypothesised that:

1. There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-test of the mathematical word-problems

This hypothesis is further divided into the following hypotheses;

1.1 There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-testing of reading the content of the mathematical word-problem.

1.2 There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-testing of understanding the content of the mathematical word-problem.

1.3 There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-testing of conversion of digits from verbal to symbolic form in the word-problems.

1.4 There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-testing of choice of appropriate mathematical operation

1.5 There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-testing of arrival at the correct solution to the word-problems.

2. There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-test of the mathematical word-problem.

This hypothesis is further divided into the following hypotheses;

2.1 There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-testing of reading the content of the mathematical word-problem.

2.2 There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-testing of understanding the content of the mathematical word-problem.

2.3 There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-testing of conversion of digits from verbal to symbolic form in the word-problems.

2.4 There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-testing of choice of appropriate mathematical operation.

2.5 There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-testing of arrival at the correct solution to the word-problems.

3. There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-test of the mathematical word-problem.

This hypothesis is further divided into the following hypotheses;

3.1 There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-testing of reading the content of the mathematical word-problem.

3.2 There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-testing of understanding the content of the mathematical word-problem.

3.3 There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-testing of conversion of digits from verbal to symbolic form in the word-problems.

3.4 There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-testing of choice of appropriate mathematical operation.

3.5 There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-testing of arrival at the correct solution to the word-problems.

4. There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-test of the mathematical word-problem.

This hypothesis is further divided into the following hypotheses;

4.1 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of reading the content of the mathematical word-problem.

4.2 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of understanding the content of the mathematical word-problem.

4.3 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems.

4.4 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of choice of appropriate mathematical operation in word-problems.

4.5 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of arrival at the correct solution to the word-problems.

5. There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-test of the mathematical word-problem.

This hypothesis is further divided into the following hypotheses;

5.1 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of reading the content of the mathematical word-problem.

5.2 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of understanding the content of the mathematical word-problem.

5.3 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems.

5.4 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of choice of appropriate mathematical operation in word-problems.

5.5 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of arrival at the correct solution to the word-problems.

6. There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-test of the mathematical word-problem.

This hypothesis is further divided into the following hypotheses;

6.1 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of reading the content of the mathematical word-problem.

6.2 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of understanding the content of the mathematical word-problem.

6.3 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems.

6.4 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of choice of appropriate mathematical operation in word-problems.

6.5 There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of arrival at the correct solution to the word-problems.

7. There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-test of the mathematical word-problem.

This hypothesis is further divided into the following hypotheses;

7.1 There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of reading the content of the mathematical word-problem.

7.2 There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of understanding the content of the mathematical word-problem.

7.3 There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems.

7.4 There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of choice of appropriate mathematical operation in word-problems.

7.5 There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of arrival at the correct solution to the word-problems.

8. 4^{th} year primary pupils' post assessment mean-scores would be significantly higher than their pre-assessment mean-scores on the mathematical word-problem attitude scale.

Statistical Analysis of Data

When the post-measurement procedures were complete, the "t" test for small samples was used to analyse the differences between means of scores of the study subjects in the pre- and the post-measurements.

Procedures of the Study

In order to attain the objectives of the present study the following steps were taken:

1. Review of the pertinent literature

2. Discussion of some selected topics related to mathematical word-problems

3. Construction of the instruments for the study (the needs assessment questionnaire, the pre-post mathematical word-problem achievement test, mathematical word-problem programme and mathematical word-problem attitude scale)

4. Evaluation of the validity and reliability of the instruments used

5. Selection of the study sample and assignment of subjects to control and experimental groups

6. Gathering of base line data; pre-testing, pre-measurement of performance and pre-measurement of pupils' attitudes towards mathematical word-problems

7. Teaching the suggested programme

8. Collection of post data; post-testing and post measurement of performance

9. Statistical analysis of data

10. Consideration of the results and discussion.

Definition of Terms

A mathematical Word-problem

According to Majumder (2003), mathematical word-problems or story problems are mathematics problems that are depicted as a specific situation. The solver is presented with a narrative that involves a manipulation of quantities, such as an exchange of items. The pupil must represent the word-problem in a quantitative or mathematical statement and carry out the computations in order to determine the final amount after the exchange occurs.

A mathematical word-problem is a real-life situation in which mathematical quantities are given, values of one or more quantities are known, values of one or more quantities are not known, relationships between or among quantities are described, a question is implied or stated asking one to find the value of one or more unknown quantities, and one or more of the operations addition, subtraction, multiplication, and division can be used to find the value of the unknown quantity or quantities and solve the problem (Charles, 2004). The current study adopts this definition as its procedural definition.

Performance

In the current study, performance on mathematical word-problems is defined as: pupils' ability to read the content of the word-problems, understand this content, convert the digits from verbal to symbolic form, choose the appropriate mathematical operation, and reach the correct solution.

CHAPTER TWO
THEORETICAL BACKGROUND AND RELATED STUDIES

Introduction

This chapter is presented in two parts. In part one, a theoretical background is given. This background is presented in ten sections. The first section deals with the development of education in the state of Kuwait; the second with the importance of mathematics teaching and learning; the third with factors affecting teaching mathematics; the fourth with the teaching of mathematics in the Arab countries; the fifth with 'mathematics anxiety'; the sixth with mathematical word-problems; the seventh with the importance of solving mathematical word-problems; the eighth with the difficulty of mathematical word-problems; the ninth with factors affecting solving word-problems; and the tenth and last section deals with pupils' approaches to solving simple mathematical word-problems.

Part two presents a review of pertinent literature in the field of mathematical word-problem teaching and learning. Relevant intervention and evaluation studies are also discussed. In an attempt to benefit from past research, the text sheds light on the important aspects of each piece of work, such as the objective of each study, the experimental design used, the sample size, the tools used, the form of analysis, and above all, the results obtained. At the end of this review, a critical comment on these studies is given.

Part One

The Development of Education in the State of Kuwait

Education in the State of Kuwait passed through many stages as it developed. During this time, many educational laws appeared laws that were aimed at supporting the different policies of education at that time. Kuwaiti education law guarantees the right to education for all Kuwaiti people, paid for by the state. In addition, the state encourages and supports scientific research in all fields.

Education in the state of Kuwait offers the opportunity for the comprehensive development of all Kuwaiti pupils; intellectually emotionally, and physically to the utmost of their capabilities. The education law came into force in 1965 to encourage individuals to develop their social behaviour by helping them to love education, making this possible for all people at no individual cost. This law stipulated that education is obligatory for both males and females, from the beginning of the primary stage to the end of the intermediate stage. The state is committed to offering books, school buildings, teachers and everything necessary for the success of the education process (Hussein and Jassim, 1990).

The law of general education in 1987 was aimed at offering rules and regulations related to educational affairs, at making educational innovations and establishing systems for the secondary education curriculum. This was in accordance with the efforts of the state which were aimed at:

- Reinforcing basic values among children and consolidating their feelings of loyalty
- Developing the quality of general education, and helping individuals to develop spiritually, intellectually and physically
- Developing abilities in independent thinking, creation and continuous self-learning among individuals

- Taking care of talented individuals and exceptional children
- Developing the abilities of individuals to understand and apply modern scientific methodologies and to benefit from modern technologies
- Confirming the links between theory and practice and between knowledge and performance
- paying attention to the upbringing of children at the pre-school stage and trying to assimilate all children in kindergartens
- Preparing and qualifying teachers and improving the calibre of people working in the field of education, in addition to reducing dependence on foreign teachers
- Relating education to the needs of society in terms of the qualified human resources needed for community development.

Reviewing the development of education in the state of Kuwait, one finds that education during the early days was religious in nature, and offered through mosques. Among the famous establishments that offered education at that time were Aal-Khalefaa, Bin-Bahar and Al-Adasaani mosques that were built in 1737. Inside these mosques, many teaching and learning sessions were undertaken (Fawzeyah, 1982).

In cooperation with the government of Kuwait, great efforts were made by Kuwaiti people in the field of education in an informal way, especially in mosques and primary schools. A primary school was a name given to the place of teaching where lessons were given by educated people. Those people used to dedicate parts of their houses in which they received children to be taught. These primary schools were widespread in all Arab and Muslim countries at that time (Sayed, 1971). From its early Arabian Islamic development, the primary school was a common educational institute for all people. It was a very modest place that accommodated a number of children who were supervised by a single teacher assisted by an assistant, or sometimes by a monitor. The first primary school in Kuwait was that of 'Al-Mulla Kaasem' which was established in 1887, when he came to Kuwait accompanied by his brother 'Al-Mulla Abdeen'. From this point onwards, Kuwait started a new phase of education in addition to education given inside mosques. After that, the 'Al-Mulla Rashed Al-Saghabee' primary school appeared in 1888, followed by that of his son 'Al-Mulla Saad'. Also, 'Al-Mulla Abdel-Wahab Alhosayaan' established his primary school upon his arrival at Kuwait in 1890 (Ministry of Education, 1983).

Teaching was verbal in both mosques and in primary schools. But teaching in primary schools was different from that of mosques in terms of the content of what was taught. In primary schools, teaching concentrated on reading and writing but inside mosques education was only religious (Abdel-Aziz, 1960).

Female education in the state of Kuwait appeared a little later than that of males. This was due to the social atmosphere at that time which did not support women's education. In 1926 the religious woman 'Amenaa Al-Omar' established the first primary school for girls. It was the first school to teach girls reading, writing and mathematics and to recite the Holy Quraan.

The establishment of 'Al-Mubarakeyah School' was the beginning of formal education in the state of Kuwait. This school was founded in 1912 and it aimed to spread education and support throughout the state (Yousof, 1968). When first opened, the school accommodated only three hundred pupils. In the first three grades of this school, each room was taught by a single teacher. As for the fourth and the fifth grades, they were taught interchangeably by a number of teachers. The headmaster of the school used to teach the grades that he chose. The school day was five hours in duration; three hours in the morning and two in the afternoon. The lessons were one hour long followed by 10 minutes rest. The curriculum at this school included:

- Islamic education
- Arabic language
- Islamic history

- Principles of geography
- Mathematics including arithmetic and geometry (Al-Ahmad, 1986).

The first council of education in the state of Kuwait was formed in 1936. It was called the council of education under the presidency of Sheakh Abdullah Gaaber Al-Sabaah. According to Abdel-Ghafour (1993), this council faced two main difficulties, the first of which was to acquire teachers from Arab countries, and the second difficulty was that of technical education.

The council continued to supervise educational affairs and to put in place plans and strategies for the development of education in general, in addition to sending delegations of pupils in search of learning to Bahrain, Iraq and Egypt. This continued until the self-government of Kuwait in 1961.

In 1962, governmental decree no. 2 was issued necessitating the reorganisation of ministries. The responsibility of the ministry of education was specified in the law governing the department on the 7th of January, 1979. This law stipulated that the ministry was to be responsible for the upbringing and the development of the Kuwaiti community scientifically, spiritually, ethically, intellectually, socially and physically in the light of Islamic principles and Arabian heritage and contemporary culture, bearing in mind the Kuwaiti environment and the achievement of its development (Badran, 1982).

On the 11th February, 1987, general education law no. 4 confirmed the responsibilities of the ministry of education in forming the Kuwaiti citizen and giving opportunities for helping pupils towards comprehensive growth, intellectually, emotionally, and physically to the utmost of their capabilities in the light of Islamic teachings and the traditions of Kuwaiti society, in addition to implanting citizenship and loyalty in pupils. This law also stated that the ministry of education was responsible for the very important role of offering education to kindergarten children and offering them educational experiences that might help them to grow and be ready for a healthy school life thereafter (Abdel-Ghafour, 1993).

In addition, this law divided education into three main stages; the primary, the intermediate and the secondary stage. This division lasted until 2004; four years of primary school, another four years for the intermediate school and four years also for the secondary school. After the year 2004, this division was changed; the primary stage lasted for five years, the intermediate lasted for four years, and the secondary lasted for only three years**.**

Thus, the history of education in the state of Kuwait went through many turning points the most important of which were:

- Establishing 'Al-Mubarakeyah School' in 1912.
- Establishing the council of education in 1936.
- Establishing the industrial college in 1955.
- Establishing the ministry of education in 1961, after Kuwaiti self-government.
- Establishing the University of Kuwait in 1966.
- Issuing the law of general education no. 4 in February, 1987.

According to Al-Ahmad (1987), based on the crucial role of education in directing and leading development in the Kuwaiti community, a report on education in the state of Kuwait was presented in March 1955. In this report and for the first time, educational objectives were outlined. They were as follows:

- Eliminating illiteracy among both children and adults in every part of the state of Kuwait
- Spreading religious principles among people and implanting ethical and noble manners derived from religion and from sound traditions and conventions such as truthfulness, honesty, fairness and tolerance
- Spreading the spirit of loyalty to Kuwait in particular and to Arab countries in general and helping pupils to know the national heritage and to keep and develop it, in addition to mastering the Arabic language both spoken and written

- Spreading the spirit of democracy among individuals and helping them to be democratic
- Implanting healthcare principles, maintaining cleanliness and teaching pupils about methods of good nutrition and protection from illnesses
- Developing a tendency towards productive hard working and supporting individual desires towards learning certain professions
- Stressing the importance of physical education and developing hobbies
- Developing creativity and supporting self-expression through fine arts such as painting, engraving, playing music and so on.

In February 1974, a committee was formed to frame the general objectives of education. This committee included some of the faculty of education professors from the University of Kuwait, in addition to some leadership from the ministry of education. The committee outlined the general objectives of education, keeping in mind the stipulations of the Kuwaiti constitution, the educational plans and the results of the studies and research in that field.

According to the Ministry of Education (1991), these objectives were derived from four guiding sources. These were as follows:

- The nature of the Kuwaiti community and its religion, philosophy and cultural heritage
- The nature of the age in which we live
- The characteristics of learners and their needs
- Contemporary educational trends.

The new objectives of education in general were outlined as follows:

- Helping individuals, as members of the community, to master functional knowledge and information in all vital fields of life
- Helping individuals to acquire appropriate functional skills
- Helping individuals to use the scientific method of thinking and to develop their creative abilities

- Developing individuals' positive tendencies and interests in a functional way.

More specifically, each educational stage has its own objectives; below are the objectives of the primary stage (Ministry of Education, 1983):

- Developing the spiritual growth of the individuals. That is, helping individuals to attain basic concepts and values of Islamic religion which help build the right Islamic faith and the right practice of Islamic worship
- Developing the intellectual growth of the individuals. That is, helping individuals to attain basic concepts, skills and information that assist them in their comprehensive growth, contribute to the shaping of personality and enable them to live in harmony with society
- Developing the psychological growth of the individuals. That is, helping the individual to attain basic concepts, and information that help them in their adjustment to society
- Developing the physical growth of the individuals. That is, helping the individual to attain basic concepts, skills and information that help them to grow physically and to enjoy appropriate activities.

After the year 2004, this division was changed; the primary stage lasted for five years, the intermediate lasted for four years, and the secondary lasted for only three years. In the past, joining university depended on the pupil's score on the final exam at the third year of secondary school. Nowadays things are different; the pupil's total score, upon which acceptance at university depends, is the sum of his/her scores in the first, the second and the third year of secondary school; 5% for the first year, 35% for the second year and 60% for the third year. This new system is regarded as better than the old one as it gives pupils more than one opportunity to attain scores. In addition, this system makes pupils interested in studying from the very beginning of their secondary school education.

More interest was given to the study subjects as well. Pupils in primary school, for example, used to study only main subjects such as Islamic religion, Arabic language, mathematics, and science. Nowadays, primary school pupils study, in addition to the mentioned subjects, English language, social sciences, patriotism, drawing, music and physical education.

As for the physical environment, we find that schools became more spacious and well organized than before. School playgrounds now have better and more suitable surfaces. Classrooms are tidier and cleaner than before. The number of pupils in classrooms ranges from 20 to 25 pupils per class. In the past classrooms were more crowded than those of today. There were between 30 to 40 pupils in each classroom in some schools. In addition, the teacher's work hours decreased. A teacher nowadays teaches fewer classes than his colleague in the past.

In order for the educational system in the state of Kuwait to cope with the modern advances in all fields of life, there are continuous experiments with curricula and methods of teaching. The results of these experiments are intended to help with the development of curricula, teaching methods, teaching aids, activities and so on.

Importance of Mathematics Teaching and Learning

The teaching of mathematics is of great interest to teachers as well as parents all over the world. This interest is due to the belief that there is a firm relationship between achievement in mathematics and the ability to think and solve problems.

According to Adams (2003: 786) mathematics is more than a subject; it is a 'language that people use to communicate, to solve problems, to engage in recreation, and to create works of art and mechanical tools. It is a language of words, numerals, and symbols that are at times interrelated and independent and at other times disjointed and autonomous' (Cited in Villa, 2008: 7). Modern trends in mathematics curricula and approaches to teaching stress the idea that mathematics is a way of thinking that depends mainly on understanding and logic and uses discovery and discussion in reaching the correct solution (Aichele & Reys, 1977). Solving mathematical word-problems, as Allan & Marissa (2005) state, is an integral part of mathematics education in most parts of the world because these problems allow pupils to apply their mathematics knowledge and skills to real-world situations. According to Yan et al. (2005), mathematics is integral to all areas of daily life; it affects successful functioning on the job, in school, at home, and in the community. Supporting this viewpoint, Verschaffel, Greer, & De Corte (2000; as cited in Wim et al., 2004: 385), add that 'mathematical word-problems are assumed to offer an acceptably good substitute for real problems that the learners may encounter outside their mathematics lessons'.

Mathematics is considered the most important subject taught to pupils in the primary stage. According to Kronley et al. (2005), mathematics is very important because it is connected to many activities in daily life that need to be explained and understood. Robyn, Shelley & Robert (2004), Khalid (2003), and Bentley (2006) stress the importance of mathematics and its objectives especially in the primary educational stage. Their studies concentrated on developing mathematics' curricula in general especially in primary education. In Kuwait, teachers as well as parents emphasise the importance of learning and teaching mathematics as it is considered to be one of the subjects that address the pupil's mind and develop his abilities for discovery and problem solving and dealing logically with everything around him.

Highlighting the importance of teaching mathematics, Jongsma (2004) makes links between mathematics teaching and that of other scientific subjects. She stresses that the significance of mathematics is its great effect in improving the creative skills of pupils. Mathematics is also crucially important in the primary stage in particular as it supports thinking skills among pupils and gives them the tools for mental growth. It also supports pupils' accuracy, curiosity, discovery and develops their intelligence. Mathematics teaching also contributes by helping pupils to acquire basic mathematical concepts for use in real life applications and, in addition, teaches an understanding of simple geometrical shapes and their characteristics. I agree with what Jongsma (2004) mentions especially because mathematics is one of the subjects that depend first and foremost on understanding and application rather than memory and retrieval. Jody & Danne (2004) stress the importance of mathematics in the primary stage as it contributes significantly to improving the pupils' performance and qualifying them for the next educational stages. They suggest that the role of mathematics and its positive effect on the pupils' faculties can be enhanced by providing an appropriate framework and educational environment, in addition to developing and improving the relationship between teachers and pupils. Bentley (2006) indicates that the teaching of mathematics in kindergarten and at primary school greatly affects reinforcement of a child's thinking skills as the primary stage is connected to a basic stage of man's development. She also adds that success in teaching mathematics at this stage requires preparation of a balanced timetable of contents which are to be taught and that these contents should be presented from easier to more difficult. In addition to agreeing with the opinions of Jody & Danne (2004) and Bentley (2006), I can confirm that Muslims, in particular, have always taught their children the rules of arithmetic and geometry because they are well convinced that this is essential knowledge that aids their children to develop an enlightened mind and personality. It is commonly held among Muslims that learning arithmetic leads to truthfulness and honesty. Haught et al. (2002) point out that the teaching of mathematics at the primary stage requires that pupils have adequate time to apply and use basic mathematical facts at home and in their daily lives. Teachers should also help develop their pupils' attitudes towards using and applying mathematics in their lives. It is true that giving primary school children enough time to think, understand and apply mathematical facts that they learn at school positively affects their learning of mathematics and at the same time will develop their attitudes towards it. Stressing the importance of teaching mathematics at the pre-school stage, Bowman (1998) states that it is puzzling that mathematics does not have greater prominence in the pre-school curriculum.

Sometimes it is possible to find people who ask 'why do we learn mathematics?' Or 'mathematics is of little or no importance'. 'What do we do with logarithms?' Actually, mathematics is a life science. It is an integral part of our life or it is everything in life. The failure to develop competencies in mathematics during school years can dangerously handicap both daily living and the professional abilities of both young people and adults. Nowadays, knowledge of mathematics and mathematical problem-solving skills are as important as literacy skills.

Factors Affecting the Teaching of Mathematics

There are a number of important factors that should be taken into consideration that affect teaching mathematics in the primary stage. John (2005), Andrew & Pettitt (1994) and Al Hakeel (1993) point out that there are a number of factors which should be taken into consideration while teaching mathematics at the primary stage and that teachers should make sure to apply them in teaching. These factors include; starting teaching mathematics with tangibles that clarify the abstract meanings of mathematics, using simple illustration aids, and following gradual concise steps that lead to pupils' understanding of mathematical concepts and terminologies. Supporting this, Ebid et al. (1998) add that one of the most important factors affecting the teaching of mathematics that should be taken into consideration by teachers at the primary educational stage is the presentation of mathematical concepts by dealing with tangible things first, then moving to semi-tangible before reaching more abstract things. I agree with what these writers say because the gradual movement from tangible to abstract is widely agreed upon and recommended in teaching children, as it is difficult for them to understand abstract concepts in the beginning of their learning. Above all, I myself as a teacher of mathematics used to teach my children this way and it usually proves to be effective.

In this respect, Mamdooh (2005) points out that there are some other factors that affect the effective teaching of mathematics. The most important of these, as he sees it, include teaching methods, pupils' performance, their previous backgrounds in mathematics and their achievement abilities. These factors, according to Mamdooh, greatly affect teaching and learning of mathematics especially at the primary stage. From a different perspective, Wu (2007) emphasizes other factors affecting the teaching of mathematics. He puts it clearly that teaching mathematics successfully requires improvement in three main areas; (1) the mathematical qualification of the teachers, (2) the mathematical coherence of the curricula, and (3) the attitude towards learning on the part of the pupils. For me, I agree with what is mentioned by both Mamdooh (2005) and Wu (2007) because the teaching and learning of mathematics is really affected by a host of factors, among which are the teaching methods used in teaching, pupils' level of performance and their prior knowledge on mathematics, teachers' qualifications, quality of mathematics curricula, and the pupils' learning aptitudes.

Thus, the effective teaching of mathematics is affected by many factors some of which are related to mathematics teachers and their ways of teaching, whilst others are related to mathematics curricula and still others are related to the pupils themselves and their attitudes towards mathematics; whether the pupil likes mathematics or not, and whether he/she thinks mathematics is an easy or a 'boring' subject.

In addition to what was mentioned above and from my own viewpoint, the effective teaching of mathematics is affected by the school environment itself; whether this environment encourages or hinders teaching of mathematics. Pupils' home background also has a powerful impact on teaching; the education level of the pupils' parents, the number of books at home and possession, or not, of a home computer are all relevant factors. External motivation, I believe, also has a crucial effect, especially in Kuwait; whether the pupil has the desire to be good at mathematics in order to enter his desired school or college, to work in his desired job, and above all, to please his parents.

The Teaching of Mathematics in the Arab Countries

According to Al-Shobakky (2005), teaching mathematics is a problem in both the developing and developed worlds. In North America educators, for example teachers, complain that even high-achieving pupils lack a good grasp of some basic mathematical concepts. Unfortunately, the situation is even worse in the Arab region. When it comes to mathematics, people lose their enthusiasm for learning. Mark Werner, chair of the mathematical software committee at the American University in Cairo (AUC), Egypt, claims that both pupils and parents alike do not think mathematics is a useful field of study and consequently, there is not much motivation for a subject with little perceived practical value (Cited in Al-Shobakky, 2005). He laments this lack of motivation towards learning mathematics, claiming that many of the problems we teach in the classroom are only stepping-stones to other, applied and usually more interesting, problems which are typically covered in other departments such as engineering.

In fact, I do not agree with the view that mathematics is a subject with little perceived practical value. The contrary is true. Mathematics is a part of our life and the mathematical problems we teach in the classroom are not only stepping-stones but also a reflection to the real life problems we experience in our daily lives.

According to the International Panel on Policy and Practice in Mathematics Education: 2001 Report, Fayez Mina and Khaled Farouk Etman state that, in Egypt, examinations are a driving force in shaping what teachers do. The teachers' aim in teaching mathematics is to cover whatever is in the syllabus and help prepare their pupils for examinations. This means that teachers' main concern in teaching mathematics is to help their pupils study the syllabus and pass the final exam. They rarely deviate from the material prescribed in the textbooks and from the pre-determined objectives. Little or no reference is made to real life problems outside the classroom. The curriculum is traditional in almost all respects. Mathematics is taught entirely separately from other disciplines and life activities. There is no connection between mathematics and other school subjects (Mansour, 1991). Little attention is given to educational activities, employing educational media, or advanced technology. The vast majority of kindergarten teachers are secondary school graduates. The ministry of education was convinced at the time that secondary school graduates could teach kindergarten children well. As for the primary level, most of the teachers are graduated from an intermediate educational programme, with or without specialization in mathematics. A 1989 policy mandated that all teachers of primary education should have a university degree, specialising in education. These mandated changes had a positive effect on primary education in general and mathematics teaching in particular. University graduates had better understanding of primary school children and of their needs for mathematics education.

According to the Arab Human Development Report 2003: Building a Knowledge Society, (Pp. 54-55), in Oman, four studies have been conducted so far to evaluate educational achievement in the fourth, sixth, eighth, and ninth grades in Arabic, mathematics, science and life skills. Two findings about these grades stand out. First, grade averages in all subjects are below excellence, or the so-called 90/90 rule (which stipulates that at least 90% of the pupils should obtain at least 90% in a standard examination that measures how far the skills taught are acquired). Second, girls outperform boys in all subjects.

In Egypt, a wide field survey revealed that mastery of the basic skills of reading and writing, and mathematics, which is supposed to be acquired through primary education, is low, about 40% and 30% respectively.

In Bahrain, an evaluation of educational outcomes at the end of the first stage of primary education, showed a low level of pupil achievement reflected in a lack of mastery of essential skills. The grade average in Arabic hit 43.7%, with a standard deviation of 24.2 on a scale of 0-100. In mathematics, the grade average was 44.9% with a 22.8 standard deviation on the same scale. In neither subject does pupil performance remotely approach mastery. Pupil scores in the two subjects cover the whole range of grades, which indicates that examinations could indeed distinguish the different achievement levels on the one hand. On the other hand, frequency distributions of the scores established the common bell curve of examination grades in a large sample (the further away from the average the grade is, the smaller the percentage of pupils becomes).

However, grade frequency distribution that deviates from the standard distribution is also important. For example, compared to the distribution of mathematics grades, the distribution in Arabic shows a higher frequency in the lower grades, and less frequency in the middle (Ibid). These findings demonstrate that the pupils' grades in Arabic tend to be lower than in mathematics.

When it comes to comparative studies with other countries of the world, only one Arab country, Kuwait, participated in the 'Third International Mathematics and Science Study, 1995'. It included pupils who were at the end of primary education from 41 countries in the world (class 8).

Kuwait's participation is highly commendable and a good example for the Arab countries to follow, especially since it took place a few years after the invasion of the country and the consequent physical and emotional impact on its education system. Yet Kuwait is an exception for other reasons. It has sufficient financial resources as well as a small population. It spends generously on education and has made outstanding progress in its quantitative expansion.

Nevertheless, Kuwaiti pupils came at the bottom of the list and ranked 39th in terms of achievement in mathematics and science, with grade averages of 392 and 430 respectively. This is 121 points in mathematics and 86 in science below the world averages (513 and 516). Compared to Singapore, which was ranked first, with grade averages of 643 and 607 respectively, Kuwaiti pupils' achievement fell below this average by 251 points in mathematics and 177 in science.

Noticeably, unlike those countries topping the list, Kuwaiti pupil achievement in mathematics was lower than in science, and more so compared to the world average. It is a well-established fact that mathematics is a crucial basis of knowledge for the sciences of the future. It is worth noting that, in this evaluation, countries such as Bulgaria, Thailand, Spain and Iran ranked above Kuwait. The example points to an important conclusion; ultimately, the quality of education does not depend on the availability of resources or on quantitative factors but rather on other characteristics closely related to the organization of the educational process and the means of delivery and evaluation.

Three Arab countries (Jordan, Tunisia and Morocco) took part in the Trends in Mathematics, and Science Study. In mathematics, Tunisia was ranked 29^{th} with 448 points. Jordan was ranked 32^{nd} with 428 points. Morocco came 37^{th} with 337 points. It should be noted that Singapore was ranked first with 604 points while South Africa was last with 275 points. In Science, Jordan was ranked 30^{th} with 450 points, Tunisia 34^{th} with 430 points and Morocco 37^{th} with 323 points. Taiwan topped the science list with 564 points while South Africa was ranked last with 243 points.

Mathematics Anxiety

In spite of its crucial role in our lives mathematics in general is often seen as a complex topic. This opinion is partly due to the nature of mathematics itself. Nevertheless, it is also related to preconceived notions and personal convictions about mathematics and the worry individuals feel about it. In fact, a significant body of research exists on mathematics anxiety and there have been a diversity of definitions of what comprises the phenomenon.

According to Ruffins (2007), mathematics anxiety's psychological symptoms may include 'feeling nervous before a math class, panicking, going blank during a test or feeling helpless while doing homework. The physiological symptoms include sweaty palms, racing heartbeat or an upset stomach. The symptoms are essentially the same as stage fright, or the "butterflies in the stomach" athletes experience before a game'.

From Thijsse (2002), anxiety in general is experienced in response to a perceived threat to an individual. This threat may be real or imagined and for those who are unable to avoid the threat, feelings of distress, confusion and fear are experienced. In addition, mathematics anxiety has been related to teachers and the classroom setting. Mathematics anxious children often show signs of nervousness when the teacher comes near, freezing and stopping work or covering it up to hide it.

According to Richardson and Suinn (1995), mathematical anxiety can be viewed as 'feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations' (as cited in Yüksel-Şahin, 2008: 179). It is true that mathematical anxiety is a feeling that is experienced when understanding or doing anything that involves mathematics whether in academic or non-academic situations. It is more of a sentimental or emotional problem than an intellectual one.

Anxiety, in general, may be apparent in the study of mathematics because mathematics offers what is perhaps the clearest and most concentrated example of intelligent learning, which is to say the formation of conceptual structures communicated and manipulated by means of symbols (Skemp, 1971; as cited in Strawderman, 2004).

The vast majority of previous studies on mathematics anxiety have focused on high-school pupils or adults, while children may also have strong and adverse reactions towards the subject. In addition, being a period of fast change, childhood could be the time in which anxiety is most evident. Although attitudes may deepen or change throughout school, in general, once formed, negative attitudes and anxiety, as seen by Newstead (1998), are difficult to change and may persist into adult life, with far-reaching consequences.

Research in the field of mathematics anxiety has identified a host of associated factors. These include environmental, intellectual and personality factors.

Mathematics anxiety, as seen by Thijsse (2002: 19-20), can be attributed to a combination of factors, among which are, 'physical, cognitive and psycho-behavioural components; physical aspects of mathematics anxiety are biological, consisting of hormonal, chemical and muscular changes in the body which results in a disability to think'.

According to Yuksel-Sahin (2008), mathematics anxiety is a multifaceted construct with affective and cognitive dimensions; personality, self-concept, self-esteem, learning style, parental attitudes, high expectation of parents, negative attitudes toward mathematics, avoidance of math, teachers' attitudes, ineffective teaching styles, negative school experiences and low degree of achievement in mathematics are among the concepts and constructs related to mathematics anxiety. As a matter of fact, this is a very good definition by Yuksel-Sahin (2008). It is an extremely comprehensive one as it shows the different facets and causes of anxiety in general.

For Newstead (1998), there is some lack of agreement about the possible causes of mathematics anxiety in children. He suggests some causes of mathematics anxiety, amongst which are, teacher anxiety, societal, educational or environmental factors, innate characteristics of mathematics, failure, and the influence of early-school experiences of mathematics. It is clear that Newstead (1998) concentrates on many causes of mathematics anxiety but mentions no single cause related to the child himself.

Dossel (1993; as cited in Thijsse, 2002), identified several factors leading to mathematics anxiety; these factors include the following:

- Personality factors (the belief that success cannot be attributed to effort)
- Feelings associated with lack of control
- Pressure of perceived authority figures (parents, teachers)

- Time pressure (to answer quickly and verbally)
- Effect of public failure (being asked to perform in front of a class)
- Right – wrong dichotomy (the teacher's attention should be directed towards effort rather than achievement).

In addition to personality factors, it is clear that Dossel (1993) seems to emphasise external causes of mathematics anxiety.

According to Cunliffe (2006), there are two main sources of mathematics anxiety; the first source is related to memorization without understanding. He explains this mentioning that, somewhere along the line, many of us have had a negative experience with math that may have been reinforced by social conditioning. For example, in North America, as Cunliffe (2006) adds, mathematics had been taught as a series of formulas to remember, with only a passing nod to the underlying logic behind them. For many of us, this lack of focus on 'why' certain formulas worked was highly problematic. Certainly, one may have remembered the formula, but what about when the problem appears in an unfamiliar context or situation? In these cases, without a proper understanding of why and how a formula works, one may find it very difficult or even impossible to recognise that this is a situation in which a specific formula is appropriate. And without an understanding of why something works, memorizing and applying formulas, even in situations where we recognise that a formula can be used, becomes trickier and more prone to errors (Ibid).

The second source of mathematics anxiety, as viewed by Cunliffe (2006), is related to sexism; up until even very recently, many young women have not been given the same confidence-building reinforcement about their ability to successfully do mathematics that young men have been receiving. Parents, teachers and counsellors have tended to stress the importance of mathematical competence to young men while failing to stress the same thing to young women. While this has definitely changed for the better in recent years, its lingering effects are still being felt. Actually, this is not the case in Kuwait or in the Muslim world. Very early in the dawn of history, the importance of mathematical competence was stressed equally to young men and young women. This is because Islam gives women as well as men the right to occupy any job they can perform and to work in all fields including business and trade. Working in business and trade requires mathematical competence, hence, the development of such competence has been duly stressed since early times.

According to Newstead (1998), depending on the individual and the task, a moderate amount of anxiety may actually facilitate performance. However, beyond a certain point, anxiety becomes debilitating in terms of performance, particularly in the case of higher mental activities and conceptual processes.

Summing up the research findings on the consequences of mathematics anxiety, Thijsse (2002) states that:

- Emotion and anxiety can have a negative effect on the ability of a pupil to learn. Learners who are anxious cannot take in information efficiently and this results in their inability to learn
- Working memory becomes busy when strong emotion is present and the pupil is unable to hold in mind all information relevant to the task in hand. This results in an inability to think straight
- Anxiety becomes devastating in terms of performance and higher mental activities and perceptual processes
- Strong emotion blocks reasoning and pupils who are under pressure always tried to remember rather than understand. This handicaps them mathematically
- Highly mathematics anxious pupils tend to avoid the difficult mathematics stimuli
- At all levels of mathematical skills, mathematics anxiety had a negative correlation with interest in scientific careers
- The speed and accuracy at which pupils complete given mathematics tasks is dependent on the anxiety that they experience

- Highly mathematics anxious pupils were willing to sacrifice accuracy in order to just finish the task
- Emotional reactions such as lack of interest or depression as well as falling motivation can be experienced by pupils who consistently experience failure, despite trying to succeed.

In fact, this is a comprehensive list of the different consequences of mathematics anxiety given by Thijsse (2002). To these consequences I can add that if not given due care and attention, mathematics anxiety may lead to more and more anxiety among our pupils. Mathematics anxiety often begins with the teacher himself. Mathematics anxious teachers most likely result in mathematics anxious pupils. Hence, helping mathematics teachers confront and control their own worries and feelings of insecurity when faced with numbers is essential for stopping the spread of anxiety among learners.

Thus, there are many factors contributing to mathematics anxiety. These include personality traits; physical and psycho-behavioural components, intellectual factors; cognitive components and memorization without understanding, environmental factors; sexism and societal and educational components, affective factors; repeated failure and the influence of early-school experiences of mathematics, and teacher anxiety and innate characteristics of mathematics.

Overcoming mathematics anxiety requires various treatment methods. Some are psychological treatments, others deal with teachers' attitudes and methodologies. For example, Cunliffe (2006) mentions the following steps to overcoming mathematics anxiety:

- Beginning by recognising that one has it. Denial of its presence is quite common as many people feel shame over being anxious. But one can't overcome something that he/she doesn't acknowledge. One should ask himself when he/she first started feeling this way
- Considering what 'mathematics situations' bring on feelings of anxiety

- Stopping the negative self-talk. Part of math anxiety is the self reinforcement of failure by assuming that one will fail and failing to try as a result
- Treating mathematics like a new language. Fluency requires practice and repetition. One should spend some time getting comfortable with new math ideas and practice math regularly
- Understanding new ideas – not simply memorizing the steps. One should try to understand how and why a mathematical idea works
- Asking lots of questions, especially 'why' questions. Some teachers may not always know the 'why' of a particular mathematical idea, but one shouldn't let that dissuade him
- Paying attention to those mathematical examples in one's textbook. They are there because they display the key ideas without other extraneous factors to confuse things. One should play with them and work through them
- Finding other people who are interested in mathematics and talking with them about the ideas you are learning. Having to place ideas into words or explain a concept to someone is a great way to build one's understanding
- If one does not understand an idea or concept, he/she should not wait for help. The longer he/she waits, the fuzzier things are going to become. A pupil should ask his/her teacher or a friend for help on the same day he/she runs into a problem that he/she does not understand
- Focusing on what one can do. Often, by starting with what one knows.

In addition to what was mentioned by Cunliffe (2006), mathematics teachers should help their pupils understand that lack of self confidence is a feeling that no one is more responsible than the pupil himself. Anxious pupils should be confident that they have capabilities and mental faculties just like other good pupils.

Martinez (1987; as cited in Thijsse, 2002), provides the following guidelines to teachers for creating an anxiety-free mathematics class:

- Matching instruction to cognitive levels – by teaching at the learners' level of cognitive development, frustration and anxiety can be prevented
- Making numbers real by exploring and using examples from everyday living
- Mastery learning – by reducing the risks and consequences of failing by competing only with themselves, working at the individual's own pace
- Teaching through play. Mathematics games and puzzles motivate learning.

I totally agree with Martinez' (1987) ideas for creating an anxiety-free mathematics class. More specifically, I stress the importance of teaching through play especially for Arab pupils who enjoy this form of learning.

As for Ruffins (2007), the following suggestions are made to mathematics teachers for overcoming mathematics anxiety:

- Providing role models in the form of a highly qualified woman or minority instructor, and introduce historical figures who were mathematicians or scientists
- Encouraging a group of pupils to talk about a mathematical problem before using numbers, mathematical symbols or equations. Showing that even wrong answers can be useful in helping other people look at the problem
- Finding a way to visualize a mathematical problem in more concrete terms, perhaps using real life questions of size, distance, time or money
- Discussing the quantitative problem in terms of ordinary words or pictures
- Translating the problem into the formal English of mathematics
- Translating the formal description of the problem into mathematical terms and only then trying to solve the mathematical equation.

These suggestions to mathematics teachers are all very beneficial and can help lessen mathematics anxiety. What I admire most is the one related to providing role models. In our Arabic and Islamic history there are numerous models in a variety of fields especially in mathematics (Al-Ghoarthismi & Ibn Sinaa) and chemistry (Jabir Ibn Haiyan & Abu Bakr Mohammad Ibn Zakariya al-Razi). Providing role models is a very effective way of teaching in our Arabic environment.

Word-problems appear to be difficult for many pupils. Pupils tend to view word-problems as a task that causes anxiety in the mathematical classroom (Kouba, Brown, Carpenter, Lindquist, Silver, Swafford, 1988; as cited in Lujan, 2009). According to Randall (2009), too many pupils continue to be unsuccessful at solving word-problems. He adds that teachers still report that developing pupils' abilities to solve word-problems is one of their most difficult and frustrating challenges. Pupils continue to have anxiety about solving problems, and they know that practice alone does not help them improve.

Wadlington (2009) suggests the following ways to overcome mathematical word-problem anxiety:

- When pupils have difficulty understanding mathematical word-problems, teachers should read the problems aloud and help the students to code the important parts. For example, pupils can underline the needed details, cross out irrelevant ideas, and circle the question
- Mathematics teachers should teach pupils a variety of multi-sensory strategies to solve word-problems. For example, they could create a picture/model or act out a problem.

All in all, mathematical anxiety is a state of mind which is developed through personal experience, and individual emotional responses to these experiences. It arises from low self-confidence, fear, failure, and negative feelings and attitudes towards mathematics learning that result from a range of encounters relating to the way mathematics is presented, taught and learnt by individuals. Fortunately, overcoming mathematical anxiety is possible through cooperation between teachers and parents, and between school and home. In the present study, I will design, implement and evaluate a programme that not only develops pupils' performance in solving mathematical word-problems, but also caters for overcoming their feelings of anxiety and consequently improves their attitudes towards mathematical word-problems.

Mathematical Word-problems

There are many definitions of a mathematical word-problem. Some of these definitions concentrate on the task undertaken by the pupils whereas others concentrate on the procedures they adopt in dealing with this task. Some other definitions concentrate on the interrelations between a given word-problem and other problems.

According to Pullman (2001:1**)** a word-problem 'is clearly a problem that is given to us in words'. But in mathematics, a word-problem means 'a whole set of skills other than those thought of traditionally as "mathematics" (that is, "arithmetic") must be called upon'. For Eskander & Salah (1998: 41) 'a word-problem is every situation that is problematic for the individual as he is required to give an answer or a solution that is not ready or available to him'. Abdul-hameed & Hosny (1992: 259) put it clearly that a word-problem is a 'situation in which the individual/s is required to undertake a task that has no available algorithm that determines the way of the correct solution'. For Mansour (1991: 53) 'a word-problem is the situation in which interrelations among its elements can be discovered via good thinking not via retrieval'.

Thus not every problematic situation can be said to be a word-problem; a situation that can be said to be a word-problem is the one that is new for the individual, has no ready solution for the individual and makes the individual feel that there is a definite objective he needs to fulfil. At the same time the individual should feel that there is some hindrance that prevents him from going ahead towards fulfiling his objective.

According to Coy (2001), word-problems are often described through questions ‘written in paragraph or sentence form that contain a mathematical concept that needs to be considered, solved or answered’ (Cited in Lee, 2006: 29). For Cawley, Fitzmaurice-Hayes, & Shaw (1988), mathematical problem-solving is defined as ‘the interpretation of information and the analysis of data to arrive at a single acceptable response or to provide the basis for one or more arguable alternatives’ (Cited in Seo, 2008: 2).

Kittell (2007: 7) claims that word-problems parallel life since life's tasks seldom appear as a set of numbers ready for calculation according to prescribed mathematical operations. For him, typical challenges that may appear in the form of word-problems include: ‘(a) making decisions about the amounts of time necessary to complete various tasks; (b) determining the best value for one's money; or (c) deciding how many supplies are needed to complete a particular project. The list of life's challenging tasks presenting themselves in the form of word-problems is infinite and confirms the strong connection between life's challenges and mathematics’.

Mayer (1992) conceptualized mathematical word-problem-solving as a two-step process, which involves problem representation and problem solution. Problem representation consists of the translation and integration of mathematical structure **(**Cited in Muoneke, 2001). For Chen (1998), the simplest arithmetic word-problems are those that provide information about two quantities before asking a question about another unknown quantity. The question can be answered either by adding the two given quantities or by subtracting the smaller one from the larger one.

Through the above-mentioned definitions of mathematical word-problem, it can be stated that a word problem is a situation or an exercise that requires the pupil to undertake some activities which require quality thinking. These activities may include recognising words and symbols, relating these words and symbols to their verbal meanings, and analyzing the relationships between words and symbols. This exercise and these activities are usually formatted in prose.

Types of mathematical word-problems

Word-problems are classified into many types. According to Reed (1999), the presentation of word-problems is classified into two broad categories: primary and multi-step **(**Cited in Michael, 2005). Simple word-problems have been organized into four major categories (Carpenter & Moser, 1982; Heller & Greeno, 1978, as cited in Chen, 1998). They are (a) change problems, in which a single quantity is increased or decreased, (b) equalizing problems, in which a quantity is to be altered such that it is equal to another quantity, (c) combine problems, in which two quantities are combined, and (d) compare problems, in which two quantities are compared.

For Muoneke (2001), there are three types of mathematical word-problem format; traditional, display, and story. The traditional mathematical word-problem consists of three or four lines of information that are followed by a question. In the display format, information in the mathematical word-problem is presented in the form of a graph or figure followed by questions. In the story format, the information can be presented in the form of a story that can range from single paragraphs to full-length stories followed by questions.

For Sohee (2003: 2), there are two types of word-problem; 'routine word-problems and non-routine word-problems'. Routine word-problems are those problems, which involve an anticipation of mathematical procedure in much the same way as it was learned. These problems can be solved directly by translating the phrasing of the problem into a number sentence that involves only one arithmetic operation. Non-routine word-problems, on the other hand, are defined as those for which the solution is less obvious, so that pupils need to give more thought in generating a solution plan.

Schoenfeld (1981) states that there are two different types of word-problem-solving behaviours; tactical and managerial. Tactical behaviour refers to 'things' to implement, for example, algorithms and most heuristics. On the other hand, managerial behaviours include; (a) choosing perspectives and frameworks for a problem; (b) deciding on a strategy for problem solution; (c) deciding whether a strategy change is needed in the light of new information and so on (Cited in Muoneke, 2001).

All in all, whatever the formats of the mathematical word-problems are, they all necessitate discovering interrelations among the different elements entailed in a given problem, through good thinking not through retrieval, and require the pupil to give an answer or a solution that is not ready or available to him. The most common types of mathematical word-problems in the Kuwaiti primary school mathematics text-books are of three types; traditional, display, and story formats.

Skills needed for Solving Mathematical Word-problems

Needless to say, solving a mathematical word-problem, as documented by the results of many studies, is not an easy job for most mathematics pupils. It needs certain skills on the part of the pupil.

According to Ballew and Cunningham (1982, as cited in Villa, 2008), skills involved in solving word-problems could be classified into four abilities; (a) the ability to read the problem, (b) the ability to set up the problem, (c) the ability to compute, and (d) the ability to integrate reading, interpretation and computation into the solution of the problem. For Cawley, Fitzmaurice-Hayes, and Shaw (1988), the complex activity of solving mathematical word-problems occurs at three stages (confrontation, exercise, and examples), which involve (a) meta-cognitive acts (i.e., planning and monitoring), (b) cognitive acts (thinking, reasoning, and strategy selection), and (c) appropriate use of skills to arrive successfully at a solution (Cited in Muoneke, 2001).

In order to succeed in solving mathematical word-problems, pupils are required to pursue four steps (George Polya, 1945; as cited in Villa, 2008). These steps are:

1. Read the problem - in which pupils are expected merely to read the word-problem without looking for anything else.
2. Understand the problem - in which pupils are expected to understand the vocabulary, question, context, setting, relevant and irrelevant information.
3. Solve the problem - in which pupils are expected to select the appropriate strategies and mathematical operations to solve the problem.
4. Look back - in which pupils are expected to check the validity of the answer by trying to apply it in the context of the problem.

It is clear that solving a mathematical word-problem is not a haphazard process. It needs a variety of skills and strategies the most important of which are, reading the word-problem well, understanding its content, converting digits included from verbal to symbolic forms and choosing the appropriate mathematical operation for the solution. It is noteworthy that reading is the most important of all skills for solving a word-problem. Simply because good reading leads to better understanding and consequently arriving at the correct solution.

Importance of Solving Mathematical Word-problems

Stressing the importance of teaching pupils how to solve word-problems over forty years ago, Polya (1962; as cited in Kanevsky, 2006: 1) said 'I hope that I shall shock a few people in asserting that the most important single task of mathematical instruction in the secondary schools is to teach the setting up of equations to solve word-problems'. In solving a word-problem by setting up equations, the pupil translates a real situation into mathematical terms. He has an opportunity to experience mathematical concepts that may be related to realities.

According to Pretli (2003), The National Council of Teachers of

Mathematics (NCTM) recommended that problem solving must be the focus of school mathematics in the 1980s, citing five reasons:

- First, problem solving is an integral component of mathematics, and the reduction of mathematics to a set of skills and exercises which exclude problem solving would be a misrepresentation of mathematics as a discipline, consequently short-changing the pupils
- Second, mathematics is employed in the understanding of, and communication within other disciplines
- Third, problem solving should be included in a school curriculum in order to arouse pupils' interest and enthusiasm
- Fourth, problem solving can be recreational, and many pupils continue to solve mathematics problems subsequent to the completion of a mathematics course
- Fifth, the inclusion of problem solving in the curriculum permits pupils to develop the art of problem solving.

Despite their artificial nature, as Bates & Wiest (2004) claim**,** conventional word-problems are likely to prevail in school mathematics. This may be due to their strong grounding in tradition, their potential for fostering mathematical thinking, their ease of use, and a lack of abundant and pragmatic alternatives. Word-problems may in fact, serve several important functions in the mathematics classroom; (a) they provide questions that challenge pupils to apply mathematical thinking to various situations, and (b), they may be an efficient means of relating this thinking to the real world.

According to Hartman (2007), teaching how to solve word-problems is a major component of the mathematics curriculum and a basic life skill that pupils need in order to solve the real-world problems that they will encounter in their everyday life. Solving word-problems shows the value of mathematics to pupils by presenting them with everyday situations requiring probability, statistics, algebra, and geometry. Solving word-problems allows pupils to see that there can be more than one 'right' way to solve a problem and that the information they gain from an incorrect solution can provide valuable clues for ultimately finding the correct answer. Solving word-problems encourages pupils to practice logical thinking as they strategize and reflect.

For Cobb (2004), problem solving encourages language and vocabulary development not only in the pupils' receptive language, as they attempt to understand the meaning of the word-problem, but also in their expressive language when they present their results and their thinking orally and in writing (Cited in Hartman, 2007).

According to the NCTM, (2000; as cited in Staulters, 2006) being a number one priority for math instruction, problem solving is an integral part of all mathematics learning. In everyday life and in the workplace, being able to solve problems can lead to great advantages. Solving mathematical word-problems, for Sohee (2003), is the one opportunity that pupils have to develop problem-solving skills.

For Contreras & Martinez-Cruz (2003), story problems have played and will likely play a prominent role in primary school mathematics. Verschaffel, Greer, & De Corte (2000; as cited in Contreras & Martinez-Cruz, 2003) mention, among others, the following reasons for the inclusion of word-problems in the mathematics curriculum: (a) word-problems provide practice for real life problem situations where pupils will apply what they learn in school, (b) word-problems motivate pupils to understand the importance of the underlying mathematical concepts because they will use such concepts and abilities to solve problems in the real world, and (c) word-problems help pupils to develop their creative, critical, and problem-solving abilities.

The importance of teaching Arab pupils how to solve mathematical word-problems, as claimed by El-Sharqawy (1993); Abo-Zeinah (1990) and El-Basuoni (1980) stems from the following considerations:

- Teaching pupils how to solve mathematical word-problems is an integral part of mathematics curricula as solving word-problems is considered to be a process through which new concepts can be taught
- A mathematical word-problem is a means of training pupils in arithmetic skills
- Through solving mathematical word-problems we learn how to transfer knowledge, concepts and skills to new situations
- Solving a mathematical word-problem is a means of invoking curiosity
- Solving mathematical word-problems is a means of training pupils to solve real life problems in the present and in the future
- Solving mathematical word-problems gives pupils the opportunity to acquire mathematical ways of thinking and it develops their creative abilities.

Thus, it can be said that mathematical word-problems are frequently used to measure pupils' ability to interpret relevant information and to assess their abilities to use their analytical and mathematical skills to solve problems in general. More specifically, word-problems are used to relate mathematics to real-life situations and problems. At the same time, problems arise every now and then. Sometimes they are small and insignificant and other times they are large and dangerous. Sometimes solving a problem is a matter of life and death and other times it is merely a matter of keeping one's sanity.

Difficulty of Mathematical Word-problems

It is commonly held among educationists that word-problems are difficult for pupils to solve in all levels of study especially during the first four years of primary school. This belief, as Abdul-Aziz (1991) claims, affected the design and teaching of mathematical curricula in the schools of the Gulf area, as we find that most mathematics books delay teaching word-problems to the end of the 2^{nd} or the 3^{rd} year at primary school.

Many attempts have been made by educational researchers to study mathematical word-problems in order to identify variables affecting their difficulty. Suppes et al. (1969) conducted a number of studies to identify these variables and found that there are statistically significant relationships between difficulty of solving word-problems and the following:

- Similarity between the mathematical operation used in solving a given problem and the operation used in the preceding solved problem
- The minimum number of mathematical operations required for solving a given problem
- Stating the given word-problem
- Length of a given word-problem.

Jerman (1973) studied the effect of the length of a word-problem on its difficulty to solve among a sample of primary school pupils. He found that the difficulty of solving a word-problem is affected not by the number of vocabulary items used as such, but by this number as related to other variables. Linville (1976) examined the effect of syntax on a problem's difficulty and concluded that changes in syntax and the level of vocabulary are significant. He concluded that the change in the syntax and the level of the vocabulary used in a word-problem significantly affects its difficulty. Sherrill (1973) investigated the effect of different presentations of mathematical word-problems upon the achievement of tenth grade pupils; he attempted to identify the difference in effect between presenting the word-problem only verbally and presenting it in a verbal way accompanied by a chart. He concluded that pupils' success with word-problems presented in a verbal way accompanied by a chart is significantly higher than their success with problems presented only verbally.

Andersson's 2008 study provides further evidence that children's substantial difficulties with mathematical word-problem solving can be attributed to several processes involved in problem solving. Besides poor skills in multi-digit calculation, arithmetic fact retrieval, and poor understanding of calculation principles, children with mathematical difficulties might have deficits related to specific problem solving processes such as establishing a problem representation and developing a solution plan. According to Al megdadi (2005), one of the most obvious difficulties that face teachers of mathematical word-problems is that pupils are unable to explain the mathematical symbols, and to understand their verbal meanings. In addition, pupils are poor in analyzing the relations among symbols in mathematics. Sainah (as cited in Timah, 2006) supports the view that despite the use of new teaching methods and techniques, the availability of up-to-date teaching materials and specialized training for all in-service teachers, teachers still experience difficulties in mathematics tutoring because pupils have many problems in learning it, especially in solving word-problems.

Koedinger & Mitchell (2004) explored the way that differences in problem representations change both the performance and underlying cognitive processes of beginning algebra pupils engaged in quantitative reasoning. They drew on analyses of pupils' strategies and errors as the basis for a cognitive process explanation of when, why, and how differences in problem representation affect problem solving. They concluded that differences in external representations could affect performance and learning when one representation is easier to comprehend than another or when one representation elicits more reliable and meaningful solution strategies than another. Essa (2002) presented a report on the difficulties associated with mathematics teaching and learning in the primary educational stage. The most important difficulties given in this report are; (1) pupils find difficulty in understanding the meanings in mathematical word-problems; (2) misunderstanding of mathematical symbols; (3) difficulty in converting the digits from verbal to symbolic in word-problems; (4) difficulty in choosing the appropriate mathematical process in the word-problem.

According to Abu Omera (2000), one of the most important difficulties in solving mathematical word-problems at the primary stage is the pupils' inability to read and comprehend the language of the problem. Abu Omera also stressed the fact that explaining the verbal meaning of mathematics' symbols is one of the most significant difficulties that face pupils in primary education, and it has the effect of reducing the pupils' achievements in mathematics at this stage.

Hanan (2000) studied factors contributing to linguistic difficulties in mathematical word-problems for 4th year female primary pupils in the Kingdom of Saudi Arabia. The results of her study indicated that vocabulary items that affect the text simplicity of word-problems are the familiar vocabularies to the pupil-girls, and which they formed from the language repertoire and not the vocabularies derived from common vocabulary lists. The study results also indicated that exchanging difficult vocabularies in mathematical word-problems with vocabularies proposed by the pupils facilitated an understanding of word-problems. In addition, there was a difference between the words used in school books and that of proposed word-problems. Burns et al. (1998) claim that the language used in school subjects, such as science, mathematics and social sciences, is often difficult for pupils to read and comprehend as it includes a variety of concepts and expressions to which they may not be exposed during their primary-school study. They added that pupils in primary school need to master reading skills and strategies that enable them to comprehend the language used in these subjects. Emphasizing the importance of reading in mathematics, Maikos-Diegnan (2000) assumes that the ability to read word-problems affects the outcome of a child’s problem solving efforts.

Trying to identify and remedy difficulties faced by primary stage pupils in solving mathematical word-problems, Hassan (1991) used a sample of mathematics supervisors, teachers and pupils in the primary stage in Assiut Governorate, Arab Republic of Egypt. Pupils were selected from the last three years of primary school. The researcher used three diagnostic objective tests to identify the difficulties faced by the pupils in solving word-problems in the 3rd, 4th, and 5th, grades of the primary school. Results indicated that there are certain difficulties among pupils of each of the three selected grades, in addition to general difficulties in all grades such as; (1) difficulty in reading the word-problem appropriately, (2) difficulty in discriminating between the given and the required in solving the word-problem, (3) difficulty in translating the word-problem from words to digits, and (4) difficulty in evaluating the correctness of solutions. These results were supported by Ana & Jimenez (2006) who attributed most word-problem solving difficulties to reading and understanding.

According to Martiniello (2007) pupils' major difficulties in solving mathematical word-problems are related to linguistic complexities. Vilenius, Piia, Aunola, & Nurmi (2008) state that difficulties in solving mathematical word-problems are related to reading and understanding these problems. As for Lee (2006), difficulties in solving mathematical word-problems are related to pupils' thinking abilities.

Trying to reduce the difficulties encountered, Edwards-Omoelwa (2007) used the 'story problem' as a method for simplifying the teaching of mathematical problems; Teong (2003) used the computer; Delinda (2004) used the comprehensive strategy method in understanding and solving word-problems, and in 2007 used diagrams to make it simple to understand word-problems and to solve them easily; Yan et al. (2005) used the SBI method to facilitate the understanding of mathematical word-problems and to increase pupils' abilities to solve them.

According to Englert et al. (1987), Parmar (1992), Parmar et al. (1996) and Rivera (1997) (as cited in Hartman, 2007), solving word-problems is difficult due to the complexity their presentation. Therefore, the mathematics pupil must have adequate linguistic, cognitive, and reading abilities in order to be able to solve mathematical word-problems. These abilities are summarized as follows:

Linguistic abilities: Before understanding what is to be solved, the pupil must first understand the statement of the problem, whether it is oral or written. Using his/her conceptual and linguistic knowledge base, the pupil must process the language and interpret the problem. This understanding of the language of the word-problem is needed to convert numerical language concepts into mathematical symbols.

Cognitive abilities. Skilful cognitive processing is crucial for successfully solving mathematical calculations and word-problems.

Reading abilities. To understand a written mathematical word-problem, all of the language processes that are required for reading comprehension are needed. Intelligence, memory functions, language skills, and especially concept information are all activated with reading comprehension, which is strongly related to language. Thus, in order to solve a mathematical word-problem, all of the language processes associated with mathematics in addition to the language processes associated with reading are needed in order to understand and solve the mathematics problem. Supporting this, Cole (2008) claims that reading interventions could be a necessary component of academic interventions designed to strengthen underdeveloped math computation skills.

Contreras & Martinez-Cruz (2003) put it clearly that word-problems, as they appear in textbooks, fail to achieve the intended goals. This failure is attributed, in part, to their stereotyped nature and the unrealistic approach needed to solve them. As a result, when faced with word-problems in which the context plays an important role in the solution process, pupils are most likely to fail to connect school mathematics with their real-world knowledge. For Lee (2006), word-problems are difficult because they involve multiple content areas which make them difficult to solve without extended knowledge and understanding. These knowledge requirements are of many aspects; linguistic, factual, schematic, algorithmic, and strategic.

According to Villa (2008: 11-13), the main sources of difficulty in solving word-problems are summarized in the following:

- **Words.** Knowledge of mathematical vocabulary items plays a fundamental role in the process of solving word-problems as solving these problems requires understanding of the general language followed by the ability to decode symbolic language into mathematical language
- **Grammar.** Knowledge of grammar is an important factor affecting the process of word-problem solution**.** Clarkson & Williams (1994, as cited in Villa, 2008) claim that the readability level of a word-problem may be influenced by the number of passive sentences, number of conditional sentences and the length of sentences
- **Irrelevant or unrelated information.** It is commonly held that the presence of irrelevant or unrelated information may confuse the pupil when solving word-problems
- **More than a single operation.** It is agreed upon by most researchers that the number of operations needed to solve word-problems may influence the level of difficulty in the process of solution
- **The structure of the word-problem.** As pupils seem to focus their attention on what is required in solving a word-problem, placing the question at the opening may lower the level of its complexity. Supporting this viewpoint, Thevenot, Devidal, Barrouillet, and Fayol (2007) confirmed that placing the question first in a word-problem results in better performance in solving these problems by children. In their relatively recent study, Thevenot and his colleagues found that 'French-speaking children with lower mathematical ability benefited most from moving the question to the beginning of a word-problem, especially for the more difficult problems' (Cited in Samelson, 2009:23). Furthermore, Zawaiza & Gerber (1993; as cited in Villa, 2008: 13) claim that 'one of the most important variables that influences the level of difficulty in solving word-

problems is syntactic or surface structure that involves the length, number of sentences and the position of the main questions'

- **Timing.** Being timed while solving a given mathematical word-problem. All of the above-mentioned factors combined together may slow pupils' completion of mathematical word-problems within a given time frame.

For Kintsch (1988) 'word-problems, like all other texts, share the ambiguity and fuzziness of all natural language. Not only formal, arithmetic knowledge is involved in understanding these problems, but all kinds of linguistic and situational knowledge. What makes word-problems hard—and interesting—are often not their formal properties, but the way a problem is expressed linguistically and the way formal arithmetic relations map into the situations being described' (Cited in Samelson, 2009: 18-19). Vanderlinde (1964) affirms that 'Among the more significant reasons why pupils have difficulty in solving problems are inability to comprehend the statement of the problem and lack of vocabulary. In nearly every investigation of the causes of pupils' difficulty in solving arithmetic story problems these factors have been closely related to low achievement' (Cited in Kittell, 2007: 21).

Studying mathematical terminology, Blessman and Myszczak (2001: 28) noted that pupils' reading comprehension was a very influential factor in solving mathematical word-problems. 'It is assumed that pupils are reading the problems correctly and comprehending what is being asked of them. Many times this is not the case ... the targeted pupils do not know how to make the connections between the words and the numbers. Pupils' lack of understanding when attempting to solve a mathematical problem is often a direct result of the inability to read the problems effectively' (Cited in Kittell, 2007: 19). Blessman & Myszczak (2001; as cited in Lee, 2006) stress that knowledge of mathematical vocabulary items is one of the problems for pupils in solving any mathematical problem. Pupils' poor mathematical vocabulary has been documented through teacher and pupil surveys and questionnaires, pupil vocabulary checklists, and through teacher observation of pupils' daily work.

According to Delgado (2007), pupils can often lack a schema with which to appropriately understand and solve word-problems because they are either unable to internalize possible strategies or the number of strategies they actually possess is limited due to instructional methods. For Hart (1996), a major cause of the difficulty in solving mathematical word-problems is related to the pupils' inability to convert the word- problems into mathematical operations that must be performed to solve these problems (Cited in Yu Ku, 2001).

I agree with all that has been discussed above. It is true that word-problems are universal concerns, that they are important but difficult, and that their difficulty is multifaceted. Yet, what was not mentioned above is that the actual concern is not with the difficulty of the problems, but the mindset pupils develop towards them. That is to say, a pupil's next-door neighbour's son thinks that word-problems are difficult, his school senior says that this is where he gets stuck and has a hard time and the pupil's teacher warns him to make sure that he practices word-problems often to get the hang of the subject because it is tricky. All these factors help develop a negative attitude on the part of the pupil towards word-problems.

Factors affecting the solving of mathematical word-problems

The solving of mathematical word-problems is affected by a variety of factors which many studies have tried to identify and classify. Vilenius-Tuohimaa et al.'s (2008) study aimed to investigate the relationship between mathematical word-problem skills and reading comprehension among a sample of 225 children. Subjects were between 9 and 10 years old and their text comprehension and mathematical word-problem-solving performance was tested. Technical reading skills were investigated in order to categorise participants as good or poor readers. Results indicated that performance on mathematical word-problems was strongly related to performance in reading comprehension. Fluent technical reading abilities increased the aforementioned skills. In addition, parental levels of education positively predicted children's mathematics word-problem-solving performance and reading comprehension skills. Foster (2007) investigated the connection between reading comprehension strategies and mathematical problem solving among 5th grade pupils. He found that visualization techniques helped and improved word-problem understanding. In a study conducted by Bernardo (2005) to determine whether the language of math word-problems would affect how Filipino-English bilingual problem solvers would model the structure of these word-problems, it was found that linguistic factors do not affect the more mathematically abstract components of word-problem solving, although they may affect the other components such as those related to reading comprehension and understanding.

Examining non-mathematical linguistic complexity as a source of DIF for English language learners (ELLs) in the Massachusetts Comprehensive Assessment System (MCAS) 4th-grade math test, Martiniello (2007) concluded that the greater the item's non-mathematical lexical and syntactic complexity, the greater are the differences in difficulty parameter estimates favouring non-ELLS over ELLS.

Examining the potential influence of learning opportunities provided in 1 U.S. and 1 Chinese mathematics textbook series on pupils' problem-solving performance by analyzing word-problem distribution across various problem types, as well as the potential influence of learning opportunities on pupils' ability to solve arithmetic word-problems, Xin (2007) found that the pattern of word-problem distribution in U.S. and Chinese textbooks directly affects pupils' success in solving problems. Herron (2007) added another factor that affects word-problem-solving performance in a study which attempted to investigate the relationship between culturally relevant word-problems and pupils' achievement level. Results showed that culturally relevant word-problems are statistically more beneficial and easier for pupils to solve.

The manner of stating word-problems was also investigated as a factor affecting pupils' performance by Allan and Marissa (2005). They explored the effects of stating word-problems in either Filipino or English on how Filipino–English bilingual pupils solved word-problems in which the solution required the application of real-world knowledge. They asked bilingual pupils to solve word-problems in either their first or second language. For some of the word-problems, real-life constraints prevented straightforward application of mathematical procedures. They analyzed pupils' solutions to determine whether the language of the word-problems affected the tendency to apply real-life constraints in the solution. Results showed that bilingual pupils (a) rarely considered real-life constraints in their solutions, (b) were more successful in understanding and solving word-problems that were stated in their first language, and (c) were more likely to experience failure in finding a solution to problems stated in their second language. Allan (2005) studied whether the language of math word-problems would affect how Filipino-English bilingual problem solvers would model the structure of these word-problems. Modelling of the problem structure was studied using the problem-completion paradigm, which involves presenting problems without the question. Results indicated that the language of the problem had no effect on problem-structure modelling. In addition, linguistic variables do not affect the more mathematically abstract components of word-problem solving, although they may affect the other components such as those related to reading comprehension and understanding.

Some other factors were found to affect mathematical word-problem solving in Lee's (2004) study which tried to examine how mathematical word-problems are perceived by problem solvers in terms of their structuredness, complexity, situatedness, and information richness. Results indicated that learners' perceptions of structuredness and situatedness had a positive effect on successful problem-solving performance. That is, the more structured a problem is perceived to be by the pupils, the more likely they are to solve the problems without difficulty. Learners' perceptions of richness had no direct effect on problem solving performance; too much information may confuse problem solvers when choosing useful information required for problem solving. On the other hand, learners' perceptions of complexity had a negative effect on successful problem solving performance. That is, the more complex the problem is, the less likely are the problem solvers to resolve it.

In Sowder and Sowder's (1982) study, presenting mathematical word-problems verbally, by using diagrams was compared to presenting them telegraphically. Results revealed that pupils' performance is better if the problems are presented with diagrams and shapes with few words than if they are presented in complete sentences or in telegraphic sentences. In a similar study by Moyer, Sowder, Threadgil & Moyer (1984), the effect of presenting word-problems in a verbal way versus presenting them telegraphically on pupils' abilities to solve these problems was also investigated. It was found that pupils' scores in solving problems presented in a verbal way are better than their scores in solving problems presented telegraphically.

Pupils' Approaches to Solving simple Mathematical Word-problems

Since the beginning of the last century, much effort has been exerted by educationists as well as psychologists (Browne (1906); Brownell (1928); Hg and Ames (1951); Groen and Parkman (1972); Secada et al. (1983); Abo-Zeinah (1990); Alawna (2002); among others) in studying pupils' approaches to the solving of mathematical problems. These efforts resulted in the following approaches:

First: addition approaches

There are three levels used by pupils in solving addition mathematical problems; the first level is direct modelling, the second is using number sequence, and the third uses number facts. As for pupils' approaches to solving word-problems, they are classified into three types:

(1) Counting-all

In using this approach, the pupil creates two sets of models representing the two numbers to be added together. Then, the pupil counts all items of the created models or his fingers starting with number 1. This approach is called counting-all. The pupil, in this approach, may combine the two sets of models together before counting or combine one of the two sets with the other or he may leave each set in its place and count its items only.

(2) Counting-on

This approach is more effective and less mechanical than counting-all. In using this approach, the pupil recognises that counting all items of the created models is of no use; therefore, he starts from the total number of one of the two sets of models and only adds the items of the other set one after another to the last item. This approach is called counting-on and it is subdivided into two types:

(2.1) Counting-on-from-Smaller Number

In this case, the pupil counts-on starting with the smaller number, then adds to it the larger number.

(2.2) Counting-on-from-Larger Number

In this case, the pupil counts-on starting with the larger number, then adds to it the smaller number.

(3) Number facts

The pupil's ability to count is not limited to direct modelling or number sequence but s/he learns and uses number facts. The pupil can add two numbers without resorting to counting-all or counting-on. S/he learns some number facts faster than others do. For example, adding equal numbers as

3+3, 4+4 or the constituent numbers of number 10, as 7+3 is easier for the pupil to learn more than other constituent numbers. This level is further divided into two parts:

(3.1) Known facts

When the pupil recalls a number fact that s/he knows and uses it in solving a given mathematical problem.

(3.2) Derived facts

When the pupil solves a given problem by using known number facts relevant to the number fact that constitutes the solution of the problem. In this case, we say the pupil derives the number fact s/he needs from another fact. For example, if the pupil wants to add 7+5 and s/he says *7+3=10, and the number 5 is 2 numbers larger than the number 3… then the solution is 12,* or s/he says *5+5=10, and the number 7 is 2 numbers larger than the number 5... then the solution is 12.*

Second: subtraction approaches

The three levels used by pupils in solving addition mathematical word-problems are used in solving subtraction word-problems. Hiebert et al. (1982) and Carpenter et al. (1981) identified some approaches of pupils using direct modelling and number sequence in solving subtraction word-problems. In illustrating these approaches, the solution of the following problem is used; A-B=F or B+F=A.

(1) Using direct modelling

Pupils solve subtraction word-problems by direct modelling through the following approaches;

(1.1) Separating-from

The pupil creates a set of models that includes A elements, then separates B from these elements, after that s/he counts the remaining elements of A to F to find the solution.

(1.2) Separating-to

The pupil creates a set of models that includes A elements, then separates some of these elements, one by one, until the number of the remaining elements becomes B. After that s/he counts the elements s/he separated from A to F to find the solution.

(1.3) Adding-to

The pupil creates a set of models that includes B elements, and then adds to it some elements, one by one, until s/he gets the number of A set. After that s/he counts the elements s/he added to get the solution.

(1.4) Matching

The pupil creates two sets of models; the first set includes A elements, and the second includes B elements. After that, s/he compares the elements of the two sets one by one until s/he finishes the elements of one set, then s/he counts the remaining elements to find the solution.

(2) Using number sequence

Pupils solve subtraction word-problems by using number sequence or counting through the following approaches;

(1.1) Counting down-from

The pupil starts counting down from the number A, then the counting sequence finishes upon reaching number B. This means that the pupil counts down and at the same time uses his fingers or any other signals to observe how many number words they utter.

(1.2) Counting down-to

The pupil starts counting down from the number A and goes on until s/he reaches the number B. At the same time, s/he observes the number of words in the number sequence that s/he uttered.

(1.3) Counting up from given

The pupil starts counting up from the number B and the number sequence should contain a number of additions necessary to finish with the number A. At the same time, the pupil must observe the number of these additions to identify the solution.

(1.4) Mental counting

In this approach, the pupil's solution depends on number facts or on deriving required facts from a known one.

Third: multiplication approaches

Pupils solve word-problems involving multiplication by using repeated addition.

For example, 3 x 4 = 12

3 = a number

4 = how many sets of that number

12 = total or product

example:

o o o

o o o = 3 + 3 + 3 + 3 = 12

o o o

o o o

This is repeated addition. The pupil adds 3 repeatedly four times, so 3 x 4 = 12, which is the answer to the multiplication problem 3 x 4.

Fourth: division approaches

Pupils solve word-problems involving division by using repeated subtraction.

For example, 20 ÷ 4 = 5

20 − 4 − 4 − 4 − 4 − 4 = 0

This is repeated subtraction. The pupil subtracts 4 repeatedly, or many times, until s/he hits zero. Each subtraction is forming a group of 4. S/he subtracts 4 five times,

so 20 ÷ 4 = 5, which is the answer to the division problem 20 ÷ 4.

Moreover, pupils make use of certain key words and expressions in solving mathematical word-problems. These words and expressions denote the type of operation needed in a given word-problem. Examples of these words are; *the total of, add, and together with*, denoting addition; *the difference between X & Z, the increase in, and cut down*, denoting subtraction; *divide, and distribute equally* denoting division; *multiply* denoting multiplication.

It is clear from the above-mentioned review that there is no clear difference between Arab pupils and other pupils in approaching word-problems. No obvious distinction was made between pupils of different cultures. Pupils of both cultures use almost the same approaches to solve mathematical word-problems.

Part Two

Mathematical Word-problem Intervention Studies

The need to improve primary school pupils' abilities to solve mathematical word-problems has been asserted by many researchers, and many have attempted to develop pupils' performance in solving word-problems. Their studies have used different techniques, different strategy-training procedures, different tasks and different study samples. Most, if not all, reported positive effects of interventions on pupils' mathematical word-problem solving. Below is a review of these studies:

In a relatively recent study, Samelson (2009) examined the relationship between arithmetic word-problem solving skills in first graders and 1) their oral language skill, 2) their non-verbal understanding of mathematical sets, and 3) rewording and gesture scaffolds designed to help the children access both the linguistic and the nonverbal content of *Compare 6* word-problems. Two groups of first graders (15 with good oral language skill and 15 with low oral language skill) solved a matched set of verbal and nonverbal arithmetic problems, followed by three types of *Compare* word-problems. Twenty first graders with low oral language skill (9 with low normal language (LN) and 11 with a diagnosis of language impairment (LI)) then solved orally-presented *Compare 6* word-problems under 4 scaffold conditions: 1) traditional wording, 2) traditional wording + gesture, 3) rewording, and 4) rewording + gesture.

Results indicated that children with low oral language skill had greater difficulty solving orally-presented arithmetic word-problems than their peers with good language skill, but performed comparably on a nonverbal arithmetic task. Using the proportion of problems solved correctly, rewording *Compare 6* word-problems was facilitative for the LN group but not for the LI group. The gesture scaffold was marginally significant for both groups. In a multiple-case study, John (2008) investigated the importance of the use of a support system in which the math text is read to the pupils through the use of a text to speech engine (audio support system) embedded in a cognitive tutoring system. In addition, this study investigated whether the use of an audio support system had any effect on the word-problem solving performance of three struggling readers when they were presented with a seven-step process to solve word-problems. Pre assessments were carried out to determine whether the participants had reading difficulties in the areas of decoding, fluency and/or comprehension that may affect their math word-problem solving performance.

Results indicated that the embedded devices did enhance the word-problem solving skills of these struggling readers. The reading barriers were reduced or removed and the programme allowed for individualization. The results also indicated that the participants utilized these embedded devices differently. This programme is written in such a way that the pupils are expected to solve the word-problems correctly because the embedded devices made it almost impossible for them to fail. Although the cognitive tutoring system seems to be an effective approach to providing ongoing practice and individualization, it appears that pupils would benefit from direct instruction from the classroom teacher who can help them to review their work, identify their own mistakes, make the necessary corrections, and bring about a more thorough understanding of the problem solving process.

The effects of using homework guides, and homework logs on pupils' abilities to solve word-problems involving basic addition and subtraction facts were studied by Hartlep (2008). Pupils received one of three versions of addition and subtraction timed tests once per week that focused on measuring automaticity of basic addition and subtraction facts. Twenty second-grade pupils participated in this action-research study. Pupils' automaticity of basic addition and subtraction facts increased over the course of this study.

Results indicated that homework guides positively affected pupil motivation to put forth more effort on homework. Additionally, word-problems that involved basic subtraction facts appeared more difficult to solve; whereas, word-problems that involved basic addition facts appeared easier to solve.

Considering the imperative need for a computer-assisted instruction (CAI) programme with cognitive and metacognitive strategies for pupils with mathematics difficulties, an interactive multimedia software, '*Math Explorer*,' was designed, developed, and implemented by Seo (2008) to teach one-step addition and subtraction word-problem-solving skills to pupils with mathematics difficulties.

The purpose of this study was to investigate the effectiveness of *Math Explorer*, which was designed to be a potential tool to deliver cognitive and meta-cognitive strategy instruction in one-step addition and subtraction word-problem-solving. Three research questions guided this study: (a) to what extent does the use of *Math Explorer* affect the accuracy performance of pupils with mathematics difficulties in grades 2-3 on computer-based tasks with one-step addition and subtraction word-problem-solving?; (b) to what extent does the use of *Math Explorer* generalize to the accuracy performance of pupils with mathematics difficulties in grades 2-3 on paper/pencil-based tasks with one-step addition and subtraction word-problem-solving?; and (c) to what extent does the use of *Math Explorer* maintain the accuracy performance of pupils with mathematics difficulties in grades 2-3 on computer- and paper/pencil based tasks with one-step addition and subtraction word-problem-solving? A multiple probe across subjects design was used for the study. Four pupils with mathematics difficulties participated in the pre-experimental and experimental sessions over an 18-week period. Each week of the intervention phase, the pupils received an individual 20- to 30-minute *Math Explorer* intervention, at most, five days. After each intervention, they took the 10-minute computer- or paper/pencil-based tests developed by the researcher. The intervention phase for each pupil lasted five to seven weeks. Two weeks after termination of the intervention phase, their accuracy performance on the computer- and paper/pencil-based tests were examined during the follow-up phases.

The findings of the study revealed that all four of the pupils were able to use the cognitive and meta-cognitive strategies to solve the addition and subtraction word-problems and improved their accuracy performance on the computer-based tests. Their improved accuracy performance found on the computer-based tests was successfully transferred to the paper/pencil-based tests. About two weeks after termination of the intervention phase, except for one pupil who had many absences and behavioural problems during the extended intervention phase, the three pupils successfully maintained their improved accuracy performance during the follow-up phase. Taken together, the findings of the study clearly provide evidence that *Math Explorer* is an effective method for teaching one-step addition and subtraction word-problem-solving skills to pupils with mathematics difficulties and suggest that the instruction, interface, and interaction design features of the (CAI) programme are carefully designed to produce successful mathematical performance of pupils with mathematics difficulties. Limitations of the research and implications for practice and future research were discussed.

In their study, ‘arithmetic for first graders lacking number concepts,’ Kamii and Rummelsburg (2008) attempted to build a cognitive foundation for number work. Two first grader groups were used in this study; an experimental group and a control group. The experimental group pupils were taught using mathematical physical-knowledge activities, such as ‘bowling,’ during the first half of the year. The control group pupils were taught using traditional mathematical instruction with textbooks and workbooks. As their arithmetic readiness developed, experimental group pupils tried more word-problems and games. At the end of the year, these pupils did better in mental arithmetic and word-problems than the control group pupils who received traditional mathematics instruction with textbooks and workbooks throughout the year.

Jitendra et al. (2007) conducted design or classroom experiments at 2 sites (Pennsylvania and Florida) to test the effectiveness of schema-based instruction (SBI) prior to conducting formal experimental studies. Results of Study 1 conducted in 2 3rd-grade, low-ability classrooms and 1 special education classroom indicated mean score improvements from pre-test to post-test on word-problem solving and computation fluency measures. In addition, pupil perceptions of SBI according to a strategy satisfaction questionnaire revealed that it was effective in helping to solve word-problems. Results of Study 2, which included a heterogeneous (high-, average-, and low-achieving) sample of 3rd graders, also revealed pupil improvement on the word-problem solving and computation fluency measures. However, the outcomes were not as positive in Study 2 as in Study 1.

Delinda (2007) examined the effectiveness of instruction focused on teaching pupils with learning disabilities (LD) to solve 1- and 2-step word-problems of different types. Three pupils with LD in Grade 8 participated in the study. During the treatment, pupils received instruction in diagram generation and a strategy that incorporates diagrams as a part of the procedure to solve word-problems. The results indicated that all pupils improved in the number of diagrams they used and in their ability to generate diagrams. Their word-problem solving performance improved. Moreover, they generated and used diagrams to solve other types of problems. Overall, the pupils were very satisfied with the instruction and would continue to use the diagrams and the strategy to solve word-problems in other classroom settings. Yan et al. (2005) investigated the various effects of two problem-solving instructional approaches - schema-based instruction (SBI) and general strategy instruction (GSI) - on the mathematical word-problem-solving performance of 22 middle school pupils who had learning disabilities. Results of the study indicated that the SBI group significantly surpassed the GSI group on immediate and delayed post-tests as well as the transfer test.

The study by Taylor et al. (2005) is an action research report. In this study, 4 teachers and 1 teacher educator used the Japanese lesson study model of professional development for 15 months in rural Carlinville, Illinois. In March 2001, 4 teachers identified a goal to improve their pupils' understanding of two-step word-problems in 2nd grade primary mathematics. Teachers completed three cycles of researching, planning, teaching, evaluating and reflecting. They were motivated, empowered, and found lesson study to be effective professional development in their rural setting. It focused on the classroom lesson; provided an effective lesson plan and hours of focused professional development; supported attempts to put into practice best professional knowledge of reform mathematics; and developed a professional community among them. In their research Bates & Wiest (2004) investigated the impact of personalizing mathematical word-problems, using individual pupil interests, on pupil problem-solving performance. Ten word-problems were selected randomly from a mathematics textbook to create a series of two assessments. Both assessments contained problems exactly as they appeared in the textbook and problems that were personalized using pupil interests based on pupil completed interest inventories. Fourth-grade pupils' scores on the non-personalized and personalized problems were compared to investigate potential achievement differences. The scores were then disaggregated to examine the impact of reading ability and problem type on the treatment outcomes. The results showed no significant increase in pupil achievement when the personalization treatment was used regardless of pupil reading ability or word-problem type.

A study by Nosegbe-Okoka (2004) described a conceptual teaching approach that helps pupils make connections between their everyday activities and mathematical word-problems. It included a brief review of the importance of teaching for understanding and described four principles of conceptual teaching; (1) use co-operative groups; (2) allow pupils enough time to act out and work out problem solutions; (3) encourage pupils to reflect on the reasonableness of their answers; and (4) accept alternative solutions. This type of teaching allows teachers to regularly evaluate pupils' understanding of problem solving situations and their thinking processes. Most of all, helping pupils make sense of story problems through the conceptual teaching approach builds their confidence in their ability to make appropriate decisions and to blend computational with common-sense answers.

Dougherty and Hannah (2004) demonstrated the use of generalized diagrams and symbols in solving word-problems for a group of 10 children selected from a grade three measure up classroom. Pupils use the diagrams to help solve word-problems by focusing on the broader structure rather than seeing each problem as an entity in and of itself. The consistent use of the diagrams is related to pupils' experience with simultaneous presentations of physical, diagrammatic, and symbolic representations used in measure up. Teong's (2003) study demonstrated how explicit metacognitive training influenced the mathematical word-problem solving of forty low achievers in a cognitive-apprenticeship, computer-based environment. Results from the experimental and case study designs revealed that experimental pupils outperformed control pupils on ability to solve word-problems on their individual written measures; experimental pupils developed the ability to determine when to make metacognitive decisions, and elicit better-regulated metacognitive decisions than control pupils.

In a study by Sohee (2003), three strategies for solving mathematical word-problems were compared in terms of their effectiveness on the performance of pupils experiencing mathematical problem solving difficulties. Cognitive strategy, drawing strategy, and keyword strategy were compared using a modified simultaneous treatment design. Results showed that the keyword strategy was most effective in helping pupils solve word-problems with greater accuracy and fluency. In Phase 2 the cognitive and the drawing strategy groups received the keyword strategy instruction. Both groups of pupils demonstrated salient increases following intervention. All three groups of pupils maintained improved levels of performance one month after the intervention. The study by Holden (2003) compared traditionalist and constructivist approaches to learning and their effects on pupil performance and motivation in solving math word-problems. Each approach incorporated electronic presentation technology to develop and deliver problems and solutions presented by the teacher in the traditionalist approach and presented by pupils in the constructivist approach. Two groups, totalling 32 pupils, participated in the study. The main part of the study analyzed academic performance for each group using a pre-test and post-test format. The instruction focused on methods for solving the pre-test problems. Post-test problems were similar to the pre-test, but could only be solved after transfer skills had been learnt. Both tests involved ratios and proportions.

The study's post-test gain scores revealed a statistically significant difference in learning performance, favouring constructivist learning over traditionalist. In addition, the motivation for learning math was significantly increased for both groups. However, the significance was not as robust for the constructivist group. The qualitative responses added insight to other possible effects on motivation.

Alawna's (2002) study investigated the effectiveness of training 6th grade primary school males and females on some mathematical word-problem solving strategies for developing their abilities in that area. The study had a pre-post control group design. A treatment and a no-treatment group were exposed to pre-post means of obtaining data. The treatment group was given training in the effective use of five mathematical word-problem solving strategies while the no-treatment group received no such training. Experimentation lasted for one semester. A't' test for small samples was used to analyze the difference between means of scores of the study subjects in the pre- and the post-measurements. Results of data analysis revealed that training subjects on the effective use of mathematical word-problem solving strategies developed their abilities in this area. Wells (2001) aimed to evaluate the effectiveness of computer-assisted instruction in teaching pupils mathematical word-problems. Research has shown that using computers affects their computational skills in this regard. The researcher randomly selected a sample of 25 pupils. After applying the pre- test, pupils were taught how to use the computer and, after two weeks, a post- test was applied to assess their scores. Results of the post-test revealed that the scores of those who were taught mathematical word-problems via computer had increased by 30%. Thus, this study indicates that computers positively affect pupils' scores and increase their computational skills with respect to solving mathematical word-problems.

The purpose of Muoneke's (2001) study was to examine the effects of a cognitive and meta-cognitive, Question and Action strategy (QAS) on the acquisition, follow-up, generalization skills, and word-problem-solving errors of high school pupils with learning problems in mathematics. This study employed a quasi-experimental design with repeated measures. Forty-seven high school pupils in grades nine to twelve enrolled in resource mathematics courses participated in the study. Twenty-six pupils in the treatment group received the intervention, while twenty one pupils in the comparison group received traditional mathematical word-problem-solving instruction. The study lasted twelve weeks. It is hypothesized that there are no statistically significant differences between the mathematical word-problem-solving skills, follow-up skills, generalization skills, and error types of pupils with learning problems in mathematics who received the QAS instruction compared to those who received traditional mathematical word-problem-solving instruction. The t -test for correlated samples and independent t-test was used to analyze differences between groups of the dependent variables to determine whether they are statistically different from each other.

The results of this study indicate that a cognitive and meta-cognitive QAS improved the acquisition, follow-up, and generalization of mathematical word-problem-solving skills of high school pupils with learning problems in mathematics. Also, QAS reduced the mathematical word-problem-solving errors and frequency of occurrence.

The study by Yu Ku (2001) investigated the effects of personalized instruction on the achievement of fourth-grade Taiwanese pupils in two-step mathematics word-problems. A total of 136 pupils from four classes in a Taiwanese public primary school served as subjects.

Subjects initially completed a 20-item Pupil Survey in which they chose their favourite foods, sports, stores, classmates and other selections. The most popular items were then used to create personalized math word-problems for the pre-test, personalized instructional programms, and a post-test. Subjects were blocked by ability based on their pre-test scores and were randomly assigned within higher- and lower-ability blocks to either a personalized or non-personalized version of the print-based instructional programme. The two-class-period programme contained instruction and practice in personalized or non-personalized form, on four types of two-step math problems; multiply-multiply, multiply-divide, divide-multiply, and divide-divide. After finishing the programme, subjects completed a pupil attitude survey and the post-test.

Results revealed that subjects in the personalized treatment made significantly greater pre-test-to-post-test gains than those in the non-personalized treatment. Subjects also performed significantly better on the personalized pre-test and post-test problems than on the non-personalized problems. As expected, subjects scored significantly higher on the post-test than on the pre-test, and higher-ability pupils scored significantly higher than lower-ability pupils.

Personalized subjects and higher-ability pupils both had significantly more positive attitudes toward the instructional programme than their non-personalized and lower-ability counterparts. The overall results suggest that incorporating the personal interests of Taiwanese pupils into mathematics instruction improves both their achievement and their attitudes toward the instruction.

The study by Marge (2001) investigated the effects of metacognitive strategy scaffolding on pupils' ability to solve complex word-problems. Participants were three classes of community college pupils in remedial math. This research investigated two instructional interventions designed to promote metacognitive activities in remedial math pupils. The first was the Jasper Series, which presents, via videotape, a complex mathematical challenge for pupils to solve. The second intervention was a Guided Self-questioning (GSQ) schema developed by this researcher for pupils to use when solving word-problems. The GSQ schema scaffolds the pupils through a series of six questions. The pupils are asked to; (1) restate the problem, (2) clarify the information given, (3) depict the story, (4) predict a range for the answer, (5) solve, and (6) evaluate their answer. The primary goal of both interventions was to enhance pupils' success in problem solving by helping them become more strategic thinkers, and thereby better able to solve complex word-problems. Both interventions incorporated the self-regulatory aspects of metacognition, were situated in a cooperative learning environment, and were aimed at helping pupils function more like expert mathematicians.

Results of the post-intervention test of complex word-problems indicated that the guided self-questioning schema was more successful in increasing pupil achievement than the Jasper series. Both intervention classes outperformed the control class.

In Doughty's (2000) study, solving mathematical word-problems using working notes was examined. This study hypothesized that pupils who have experience of making notes whilst solving problems would perform better than those who tackle the problem without making notes. The researcher randomly selected a sample of 88 pupils who were divided into two groups; an experimental group that used writing and solving and a control group that used solving only. After 13 weeks of experimentation, a post-test consisting of 15 word-problems was applied to the two groups. Results indicated that there were no statistically significant differences between the two groups which contradict the above-mentioned hypothesis.

The study by Stellingwerf & Van Lieshout (1999) is a two factorial pre-test-post-test-control quantitative study that was carried out in the Netherlands with 122 pupils with mean age of 11.3 years. These pupils had learning problems or require special educational needs. The purpose of the study was to gain more information about instruction methods that would improve how well children with learning problems are able to solve word-problems. Three instructional methods or treatments were examined as a part of this study; using external representation with manipulatives only, using mathematical representation with number sentences only, or using a combination of both. The treatments are embedded in a computer programme because the computer can provide direct feedback and is able to diagnose pupils' abilities. For this study the manipulatives are icons on the computer screen. The 122 participants in the study were randomly placed into four treatment groups and one control group. One group learned to solve word-problems by writing open and closed number sentences only. A second group learned to solve word-problems using manipulatives only. The manipulatives were combined with writing open and closed number sentences for the third group. A fourth group was taught to solve number sentences without manipulatives or without writing number sentences. In the four treatment groups, participants were given corrective feedback when errors occurred during the lesson. A fifth or control group received no treatment at all.

One hypothesis for the study is that pupils in the groups receiving the manipulatives only, number sentence only, or a combination of the two treatments will outperform pupils who are taught to solve the word-problems without benefit of either. A second hypothesis is that pupils in any of the four treatment groups will outperform pupils in the control group.

The experiment consisted of four stages. In the pre-test stage participants were given a paper and pencil test to assess their reading level, non-verbal intelligence, ability to write number sentences, and ability to solve word-problems. In the second, or the computer training stage, pupils were individually instructed on how to use the computer programme. The third, or treatment, stage consisted of 12 individual sessions of up to 30 minutes per session on the computer. The problem was read to the pupils and each treatment group was limited in the time they could work before entering an answer to the problem on the screen. Feedback was provided if the solution was incorrect. At the post-test, stage the four treatment groups were administered two performance tests via the computer and a third paper and pencil post-test was administered to all five groups.

A factorial repeated measurement ANOVA was carried out to test the first hypothesis. From this analysis, there was some evidence that highly competent children were better off with the writing number sentence only treatment than with the combination of writing number sentences with using manipulatives. An ANOVA was carried out to test the second hypothesis and partially supported it, indicating that participants who received the manipulatives only treatment as well as those who learned to solve the word-problem without manipulatives or without writing down the number sentences did better than the control group that received no treatment.

The conclusion of the study is that children with learning disabilities benefit from computer aided instruction for solving simple arithmetic problems. In addition, the implication for designing instruction is that using manipulatives, writing number sentences, and teaching children to use mental methods to solve word-problems can each have a positive effect on improving pupils' ability to solve word-problems.

In a study by Jitendra et al. (1998), the differential effects of two teaching strategies, an explicit schema-based strategy and a traditional strategy, on the acquisition, maintenance, and generalization of mathematical word-problem solving were examined. Thirty-four primary-aged pupils who suffered from mild mathematical disabilities' were randomly assigned to each of the 2 treatment conditions (schema and traditional). Results indicated that both groups' performance improved from the pre-test to the post-test. All pupils were able to maintain their use of word-problem-solving skills and generalized the strategy effects to novel word-problems. However, the differences between groups on the post-test, delayed post-test, and generalization test were statistically significant, favouring the schema group. In addition, scores on the immediate post-test (77% correct) and delayed post-test (81% correct) for the schema group approached those of a normative sample of 3rd graders (M = 82 % correct). In a study conducted at California State University, Asha and Hoff (1996) examined the effects of a schema-based direct instruction strategy on the word-problem-solving performance of three third- and fourth-grade pupils with learning disabilities. An adapted multiple-probe-across-pupils design was used. Results indicated that the intervention was successful in increasing the percentage of correct solutions to word-problems for all pupils. In addition, maintenance of word-problem solving was seen 2 to 3 weeks after the study. Pupil interviews indicated that the strategy was beneficial.

Critical comment on the above reviewed studies

An analytical look at the above-mentioned studies shows the following:

- The vast majority of studies share one common goal which is to investigate the effectiveness of certain variable/s on pupils' ability to solve mathematical word-problems
- ✓ The studies of Asha & Hoff (1996), Jitendra et al. (1998), Yan et al. (2005), and Jitendra et al. (2007) investigated the various effects of schema-based instruction strategy on pupils' word-problem-solving performance
- ✓ The studies of both Marge (2001) and Teong (2003) examined the various effects of metacognitive strategy scaffolding and explicit metacognitive training on pupils' word-problem-solving
- ✓ The studies of Muoneke (2001) and Seo (2008) examined the various effects of cognitive and meta-cognitive strategy instruction and the effects of a cognitive and meta-cognitive Question and Action strategy on pupils' word-problem-solving
- ✓ The studies of Alawna (2002) and that of Sohee (2003) attempted to investigate the effectiveness of using different word-problem solving strategies such as cognitive strategy, drawing strategy, and keyword strategy on developing pupils' word-problem-solving abilities
- ✓ The studies of Doughty (2000), Yu Ku (2001), Wells (2001), Dougherty & Hannah (2004), Bates & Wiest (2004), Hartlep (2008), and John (2008) studied the effectiveness of a variety of techniques and strategies on pupils' word-problem solving abilities. Respectively, these studies examined the effectiveness of using writing word-problems, the effects of personalized instruction, the effectiveness of computer-assisted instruction, the use of generalized diagrams and symbols, the impact of personalizing mathematical word-problems using individual pupil interests, using homework guides, and homework logs, and the importance of the use of a support system in which the math text is read to the pupils through the use of a text to speech engine (audio support system) embedded in a cognitive tutoring system.

- Most of the above-mentioned studies resulted in important conclusions such as:
  - ✓ Children with low oral language skill had greater difficulty solving orally-presented arithmetic word-problems than their peers with good language skill
  - ✓ The embedded devices did facilitate the word-problem solving skills of struggling readers
  - ✓ Homework guides positively affected pupil motivation to put forth more effort on homework
  - ✓ Schema-based instruction (SBI) is effective in helping solve word-problems
  - ✓ Generating and using diagrams is effective in improving pupils' word-problem solving performance
  - ✓ Personalizing mathematical word-problems using individual pupil interests is ineffective in raising pupil problem-solving performance
  - ✓ The keyword strategy is highly effective in helping pupils solve word-problems with greater accuracy and fluency
  - ✓ Training subjects on the effective use of mathematical word-problem solving strategies developed their abilities in solving word-problems
  - ✓ Computers positively affect pupils' scores and increase their computational skills with regard to solving mathematical word-problems
  - ✓ A cognitive and meta-cognitive, question and answer strategy (QAS) improved the acquisition, follow-up, and generalization of mathematical word-problem-solving skills of high school pupils with learning problems in mathematics. Also, QAS reduced the

mathematical word-problem-solving errors and frequency of occurrence

- ✓ Personalized instruction significantly improved pupils' achievement and their attitudes toward the instruction
- ✓ The guided self-questioning schema was more successful in increasing pupil achievement than the Jasper series
- ✓ Schema-based direct instruction strategy is successful in increasing the percentage of pupils' correct solutions to word-problems.

On the whole, the above-mentioned studies provided an insight into how experimental investigations are conducted, and that will be of great use when conducting the present study.

Evaluation Studies

A study by Ebraheem (2005) attempted to investigate the effect of using a suggested programme, based on computer games, on primary school children's acquisition of some geometrical concepts and skills and on their attitudes towards mathematics. The study had a pre-test-post-test experimental and control group design. Two groups were used in this study; an experimental group and a control group. Experimental group children studied a suggested programme that uses computer games whereas, the control group girls studied the same content without using such games. A pre-post test in geometry and an attitude scale were used in this study. Results indicated that the suggested programme had positive effects on children's acquisition of geometrical concepts and skills and on their attitudes towards mathematics.

Rajeh's (2002) study aimed to investigate the effect of using a suggested programme, that used computers, to develop some critical thinking skills and level of achievement in mathematics among first year secondary girls in Riyadh.

Two groups of forty three pupils were used in this study; an experimental group and a control group. Experimental group girls studied a suggested programme that used PowerPoint whereas, the control group girls studied the same content without using PowerPoint. Two pre-post tests were used in this study; an achievement test in geometry and a test that measures critical thinking in mathematics. Results indicated that experimental group girls outperformed those of the control group in mathematics achievement and in the levels of understanding, analysis and remembering.

Roti et al. (2000) described a programme for enhancing pupils' comprehension of the language of mathematical problems among 5^{th} and 6^{th} grade multi-age pupils. Evidence for the existence of this problem included math test scores, teacher observation of maths problem solving processes, and pupil reflective journals. Analysis of probable cause data revealed that pupils cannot solve mathematical problems due to a number of factors. They often had difficulty figuring out the relationship between the words and the symbols in mathematical problems. They often relied on superficial cues that can lead to incorrect solutions, or solutions that make little sense in terms of the language of the problem. In addition, the language itself used in mathematical problems is different from pupils' everyday language and can cause some comprehension difficulties in terms of solving the problem. The interventions used in this study included co-operative grouping, vocabulary interventions, teacher-pupil modelling, and pupils' reflective journals. From post intervention data, divergent approaches in problem solving strategies were thought to be a key factor in encouraging pupils to think more broadly than they had before the intervention.

The study of Al Sharbat & Khalil (2001) aimed to develop the basic mathematical skills that could help learners to perform daily mathematical processes efficiently using different tools and methods. A programme was designed that contains all aims and objectives of the mathematical syllabus of the first literacy level together with the teaching procedures used and all kinds of educational aids and evaluation means. Two groups were randomly selected; the experimental group which included 39 learners and the control group that included 38 learners. The suggested programme was implemented over 52 teaching periods and evaluated through its impact on pupils' achievement and problem solving.

The results showed that the suggested programme was effective . Statistical differences were found in the average grades of the adult learners in the first literacy level between the two study groups in the post-test results of mathematical achievement. These differences came out in favour of the experimental group. Similar results appeared in pupils' ability in problem solving.

Kousa (1999) attempted to investigate the effect of using a suggested problem-solving-based programme that develops achievement and creative thinking in mathematics among intermediate-school girls in Makkah. The study had a one group pre-test-post-test design. The group was pre-tested by using a pre-post mathematics achievement test and a creative thinking test. Then, a suggested problem-solving-based programme in mathematics that develops achievement and creative thinking was taught, after which, the group was post tested by using the same tests. Results revealed that girls' post measurements of achievement and creative thinking in mathematics were significantly higher than those of the pre measurements.

Benko (1999) described a programme for improving primary school pupils' ability to solve mathematical word-problems. The targeted population consisted of primary, middle, and junior high pupils attending two different kindergarten through eighth grade schools. Pupils' weakness in the area of problem solving was documented by teacher-devised tests, journaling, standardized test scores, pupil surveys, and teacher surveys. Research literature and measurement tools revealed the following probable causes: inability to read story problems adequately; poor reading ability in general; improper strategy use; lack of strategy use; lack of desire to properly understand the mathematical logic of the problem; strategies that rely on memorization; insufficient instructional time spent on problem solving; and inadequate time spent on finding solutions. Seven major categories of intervention were selected for use in this study; problem of the day, co-operative grouping, pair/sharing, illustrating problem data, maths journaling, classification of word-problems, and use of analytical worksheets. Post intervention data indicated an increase in strategy use, a positive change in pupil attitude towards word-problems, and an increase in time spent on each problem solution.

A study by Al-Ghazo (1994) tried to investigate the effect of using a suggested training programme that develops motivation and achievement in mathematics among girls of the fifth and eighth grades of basic education in Jordan. Two groups were used in this study; an experimental group and a control group. Experimental group girls studied a suggested training programme based on games whereas, the control group girls studied the same content without using such games. Results showed that experimental group girls surpassed control group girls in mathematics achievement and that their motivation increased significantly towards achievement in mathematics.

Barakaat's (1992) study investigated the effect of using a learning package in mathematics on 4th year basic education low-achievers' attainment level in mathematics in Jordan. The study had a one group pre-test-post-test design. First, the group was pre-tested by using a pre-post mathematics achievement test. Then, a learning package in mathematics for developing achievement was taught, after which, the group was post tested using the same test. Results revealed that subjects' post measurement of achievement in mathematics was significantly higher than that of the pre measurement and that the designed learning package was effective in developing low-achievers' attainment level in mathematics.

Critical comment on the above reviewed evaluation studies

An investigative look at the previous studies reveals the following:

- Most of the evaluation studies reviewed above are Arabic studies conducted in Arabic environments. This gave me confidence to continue with the investigation and greatly increased my expectations of successfully achieving the objective.
- Subjects in most of the above-mentioned studies are primary or intermediate school pupils. This may be due to the assumption held by educationists that word-problems are difficult for pupils to solve in all levels of study especially during the first four years of primary school. In addition, teachers still report that developing pupils' abilities to solve word-problems is one of their most difficult and frustrating challenges.
- All of the above-mentioned evaluation studies are experimental in nature. The current study also uses the experimental design in achieving its goals.
- The evaluation tools used in these studies included diagnostic tests, achievement tests and attitude surveys. The current study uses these kinds of tools for measuring the effect of its suggested programme, and for identifying change in pupils' attitudes towards mathematical word-problems after attending the suggested programme.

Summary

In the first part of this chapter, I presented a comprehensive theoretical background about many topics related to this study. A clear and broad overview of education and the development of the educational system in the state of Kuwait was given. Being part and parcel of life in general, mathematics was discussed extensively within this theoretical background. I discussed the importance of teaching and learning mathematics as a life skill and the different factors affecting its teaching and learning. I also tackled the status quo of the teaching of mathematics in the Arab countries. Mathematics anxiety as a very common symptom, suffered by most mathematics learners, was given due emphasis in this chapter.

Being central to this study, mathematical word-problems were also extensively discussed in this part of the chapter. I discussed what is meant by word-problems, the importance of solving these problems for school children, the difficulties experienced by children in solving them, the factors affecting their solutions and pupils' approaches to solving simple mathematical word-problems. In the second part, a brief review of available intervention and evaluation studies is given. Finally, a critical comment on both intervention and evaluation studies was also presented.

In the present study, I will diagnose the difficulties experienced by Kuwaiti primary school pupils in solving word-problems and therefore assess their needs for training and instruction. Pupils' difficulties will be diagnosed in five main areas: reading the content of mathematical word-problems, understanding their content, converting digits from verbal to symbolic forms, choosing appropriate mathematical operations, and arriving at the correct solution.

After that, I will design, implement and evaluate a mathematical word-problem training programme that will develop Kuwaiti primary school pupils' performance in solving word-problems. The present study will benefit from the literature reviewed and from all the related studies in designing, implementing and evaluating its suggested programme.

CHAPTER THREE
METHODS AND PROCEDURE

Introduction

The present chapter includes a description of the experiment, the experimental design used and the different variables of the study. In addition, a description of the study sample and the method of selecting it are also presented in this chapter. More importantly, an elaborated description of the different tools used and the exact procedures followed in preparing and administering these tools are also given. Finally, an overview of how the suggested programme was administered to the subjects of the study is given.

The Experiment

The study has been conducted on 4th year primary school pupils in Kuwait.

Table (2)

A table showing the schedule of the administration of the pilot tests, the real tests, and the teaching of the suggested Programme

Name of Tool	Type of Tool
Mathematical word-problem diagnostic test	Pilot study test
Needs Assessment Questionnaire	Real needs assessment Questionnaire
Pre-post Mathematical word-problem Achievement test	Real pre-test
Pre-post Mathematical Word-problem Achievement Test	Real post-test
Mathematical Word-problem Attitude Scale	Real attitude scale
Mathematical Word-problem Attitude Scale	--------------------
A programme for training 4th year primary pupils in solving mathematical word-problems	

Design of the Experiment

The study had a pre-test, post-test control group, quasi-experimental design. An experimental group and a control group were exposed to a mathematical word-problem achievement pre-test, post-test and a mathematical word-problem attitude scale. The treatment group was given direct and explicit training on how to solve mathematical word-problems, while the pupils of the no-treatment group received no such training; they were taught the same material they normally study at school.

Variables

1. The independent variable was:
   - **a)** Training in how to solve mathematical word-problems.
2. The dependent variables were;
   - **a)** Pupils' performance in reading mathematical word-problems
   - **b)** Pupils' performance in understanding word-problems
   - **c)** Pupils' performance in converting digits in word-problems from verbal into symbolic forms
   - **d)** Pupils' performance in determining the appropriate mathematical operation in solving word-problems
   - **e)** Pupils' performance in arriving at the correct solution to mathematical word-problems.

The study sample

As described in Chapter 1, the study sample comprised 100 4th year primary school pupils from two different schools; one for girls and the other for boys; fifty (50) from Hisham Ibn Omayaa primary school for boys and the other fifty (50) from Lobaba Bint Al-haareth primary school for girls. They were assigned to four groups; two groups in each school, one of which was experimental and the other a control.

Instruments of the Study

The instruments of the study included:

1. A needs assessment questionnaire
2. A mathematical word-problem training programme
3. A Mathematical word-problem achievement test
4. A mathematical word-problem attitude scale.

Needs Assessment Questionnaire

Setting up any training programme usually begins with needs assessment. Specialists in programme development have emphasized the necessity for needs assessment in the development and implementation of both new and on hand educational programmes. Rossett (1993, as cited in Mitchell, 1993) stated four reasons for needs assessment:

- It is what we do before we do or recommend anything to anybody
- It is a method for reaching out, understanding and serving the customers, organizations and missions
- It is a form of consultation where we both provide services and develop customers
- It is the method that education organizations and professionals use to ensure involvement and gather information.

Confirming what was stated by Rossett (1993), I add that by identifying pupils' actual level of performance in solving word-problems, teachers can diagnose the needs of their pupils for mathematical word-problem training and instruction.

Being one of the bases upon which the programme designer depends when designing his programme, needs assessment should be accurate. In assessing the needs of the present study's subjects, I used a 5-item, 5-point Likert-scale questionnaire. It was a 5-item questionnaire to cover the five main areas of difficulty most probably experienced by primary school pupils. On the other hand, it was also a 5-point Likert-scale questionnaire as this is the most commonly used and suitable type in needs assessment. The questionnaire aimed to identify 4th year primary pupils' difficulties in solving mathematical word-problems from primary school mathematics teachers' points of view, and therefore, to diagnose their needs for mathematical word-problem training. One hundred teachers were surveyed using the questionnaire.

To construct the present questionnaire, I reviewed related literature and some studies that had used questionnaires as a study tool (Jitendra et al., 2007; Hassanein, 2004; Xin Y, 2002; Ahmad, 1998; among others). This review gave me an insight into the way in which questionnaires are constructed, administered and analysed. At the same time, I visited numerous schools in Kuwait where I met with many mathematics experts and teachers in semi-formal meetings. They provided me with insight into teachers' perceptions of the difficulties experienced by primary school pupils in solving mathematical word-problems. Moreover, I made use of my nine-year experience of teaching and marking primary school mathematics examination papers in Kuwait. Thus, through live observation, reviewing related literature as indicated at the end of chapter three, and through meetings with members of the teaching staff as well as the pupils, I was able to build a list of difficulties which allowed me to put together the content of the questionnaire.

In this questionnaire, primary school mathematics teachers were asked to choose the option that best describes their attitude towards each difficulty that 4th year primary school pupils actually experience when solving mathematical word-problems.

Avoiding the possibility of misunderstanding, I tried to make the language of the questionnaire simple, specific, free of bias, not patronising, technically accurate and appropriate for the level of the respondents.

Validity of the Questionnaire

'Validity is the ability of an instrument to measure what it is designed to measure' (Kumar, 1999: 137). The validity of the questionnaire is the extent to which it measures what it is supposed to measure and nothing else. In other words, a questionnaire is valid to the degree to which its items measure what the analyst intends to measure.

According to Gorsuch (1997), whereas reliability can be estimated mathematically, validity is really only an argument, or a claim. Validity can be estimated through indirect means, such as asking a panel of 'experts' to judge whether a measuring instrument is valid, or by giving it to a group of 'masters', people one knows who have the trait the researcher is trying to measure. Drawing on this, a panel of Jurors which consisted of some university professors, specialists in mathematics, specialists in methodology, mathematics experts, senior inspectors and senior teachers of mathematics was selected to judge the instruments of this study. The questionnaire was e-mailed to the members of this panel of jurors (see appendix 1, p. 214) who made their remarks concerning the stating of the questionnaire's items, formatting of the questionnaire, fitness to the group of the study and the extent to which the questionnaire's items measure what I intend to measure.

The panel of jurors' comments revealed that:

- The questionnaire's items were well stated
- The formatting of the questionnaire was good
- The questionnaire's items were fit for the group of the study
- The questionnaire's items measure what I intended to measure
- The scoring scheme was fit and valid for obtaining reliable scores
- Instructions were clear.

The panel of jurors gave some suggestions of great importance that included:

- Deleting an item from the preliminary version of the questionnaire, that was irrelevant to the questionnaire's objectives. This item was connected with *analyzing the content of mathematical word-problems*
- Rephrasing a few sentences that belonged to two items. For example, in item (4) of the questionnaire the sentence that says *choosing the appropriate mathematical operations in solving mathematical word-problems* was *choosing the mathematical operations in solving mathematical word-problems* in the preliminary version of the questionnaire. In item (5), the sentence that says *arriving at the correct solution to mathematical word-problems* was *reaching the solution to mathematical word-problems* in the preliminary version of the questionnaire.

All comments of the panel of jurors were taken into consideration in order to improve the validity of the questionnaire.

Reliability of the Questionnaire

The reliability of the questionnaire refers to the stability and consistency of its scores. 'In reliability, we are concerned with consistency and the stability of a score' (Louis & Marylin, 1978: 111). Thus, a questionnaire is said to be reliable if the scores of its respondents are stable.

I sent the questionnaire via e-mail to a pilot sample of 30 primary school mathematics teachers asking them to respond to its items. Those teachers were not included in the group of teachers who responded to the real questionnaire. When I received the completed questionnaires, I rated them and kept a record of the teachers' scores. After approximately a month, the exercise was repeated.

In assessing the reliability of the present questionnaire, Cronbach Alpha was used to check the reliability and internal consistency of the composite variables, based on the rationale that items measuring the same construct will be highly correlated. Ideally, the alpha coefficient should be greater than 0.7 (Hair et al., 2006). Using SPSS, the reliability of the questionnaire was found (r=.888). This indicates that the items are correlated and address the research problem. *For the raw scores of the pupils of the pilot study sample in the two administrations of the needs assessment questionnaire, which were used to calculate its reliability, see table 68, appendix 6, p. 288.*

Reliability Statistics

Cronbach's Alpha	N. of Variables
.888	2

Content of the Questionnaire

The questionnaire, in its final form, consisted of five items and an open question that asked for mention of any other difficulties. The first item was to identify difficulties experienced by 4th year primary school pupils in reading the content of word-problems; the second was to identify difficulties experienced in understanding the content of word-problems; the third was to identify difficulties experienced in converting digits from verbal to symbolic forms in word-problems; the fourth was to identify difficulties experienced in choosing the appropriate mathematical processes in solving word-problems and the fifth was to identify difficulties experienced in arriving at the correct solution to word-problems.

There were five options alongside each item. The teacher had to choose either 'a', 'b', 'c', 'd', or 'e', where 'a' indicates that the teacher strongly disagrees with the respective statement, 'b' indicates that the teacher moderately disagrees with the respective statement, 'c' indicates that the teacher somewhat agrees with the respective statement, 'd' indicates that the teacher moderately agrees with the respective statement, and 'e' indicates that the teacher strongly agrees with the respective statement. For more details, see appendix 3, p. 219.

Scoring the Questionnaire

As previously mentioned, the questionnaire used here was a 5-point Likert-scale questionnaire. The values given to this scale were; 4 for point (e) *strongly agrees with the respective statement*; 3 for point (d) *moderately agrees with the respective statement*; 2 for point (c) *somewhat agrees with the respective statement*; 1 for point (b) *moderately disagrees with the respective statement*; and zero for point (a) *strongly disagrees with the respective statement*. The score of any option in the scale of this questionnaire is the score resultant from multiplying the number of responses by the value given to the respective point on the scale and the maximum score for any option is the score resultant from multiplying the total number of subjects by the value given to the respective point on the scale.

The total score of any statement (area of difficulty) in this questionnaire is the sum of the scores of the five options. The percentage of the total score of any statement is the percent of this score of its maximum score. This percentage is used to decide whether or not an area of difficulty is experienced by the subjects.

Administration of the Questionnaire

I sent the questionnaire via e-mail to one hundred primary school mathematics teachers in the state of Kuwait asking them to respond to its items. The response rate was 80%. This means that eighty primary school mathematics teachers out of the one hundred responded to the e-mailed questionnaire. The interpretation of the questionnaire was based on the percentage responses of the subjects as stated in the following table.

Table (3)

Total Scores of Different Areas of Difficulty and their Percentages of the Maximum Score in the Needs Assessment Questionnaire

Item No.	Areas of Difficulty	Subjects	Options					Total Score	Percentage
			(a) 0	(b) 1	(c) 2	(d) 3	(e) 4		
1	Reading the content of mathematical word-problems	80	10	10	30	10	20	180	56.25%
2	Understanding the content of mathematical word-problems	80	0	0	15	30	35	260	81.25%
3	Converting the digits from verbal to symbolic forms in mathematical word-problems	80	10	15	10	15	30	200	62.5%
4	Choosing the appropriate mathematical operations in solving mathematical word-problems	80	0	0	9	38	33	264	82.5%
5	Arriving at the correct solution to mathematical word-problems	80	0	0	5	28	47	282	88.125%

Table (3) shows total scores of different mathematical word-problems' areas of difficulty and their percentages of the maximum score on the needs assessment questionnaire. The interpretation of the questionnaire's results was based on the percentage responses of the respondents. According to the percentages obtained, it was decided whether or not an area of difficulty was experienced by 4th year primary school pupils in solving mathematical word-problems. Areas of difficulty that scored 50% and above, were considered present and experienced by 4th year primary school pupils and therefore included in the suggested programme. I chose this cut-off point because in our Arabic culture 50% is considered the border line between success and failure, and half the way between there is and there isn't something. For example, if a pupil gets 50% in a certain subject, he passes it but if he gets 49.9% he fails.

According to the percentages obtained, five main mathematical word-problem areas of difficulty were experienced by 4th year primary school pupils in Kuwait. These areas of difficulty constituted the objectives that the suggested programme was intended to achieve. They were the following difficulties:

(1) Reading the content of mathematical word-problems

(2) Understanding the content of mathematical word-problems

(3) Converting the digits from verbal to symbolic forms in mathematical word-problems

(4) Choosing the appropriate mathematical operations in solving mathematical word-problems

(5) Arriving at the correct solution to mathematical word-problems.

It is worth mentioning that arriving at the correct solution to mathematical word-problems is the area of difficulty that scored the highest percentage (88.125%) followed by choosing the appropriate mathematical operations in solving mathematical word-problems (82.5%), and by understanding the content of mathematical word-problems which scored 81.25%. However, reading the content of mathematical word-problems and converting the digits from verbal to symbolic forms in mathematical word-problems, scored the lowest percentages among the five areas of difficulty; they scored 56.25% and 62.5% respectively.

As for the responses of the primary school mathematics teachers' to the open question that asked for mention of any other difficulties, 47 teachers (58.75%) left it blank, whilst 33 (41.25%) felt that the difficulties identified were the only ones experienced by primary school children while solving word-problems.

These results indicate that 4th year primary school pupils experience unacceptable difficulty in choosing the appropriate mathematical operations when solving mathematical word-problems. They usually suffer from their inability to choose the correct and appropriate mathematical operation, and therefore they cannot easily arrive at the correct solution to mathematical word-problems. At the same time, they find it difficult to understand the content of mathematical word-problems, which also contributes to their inability to arrive at the correct solution to mathematical word-problems. However, they experienced relatively little difficulty in reading the content of these word-problems and in converting the digits from verbal to symbolic forms. These results are in line with the conclusions of Mamdooh (2005) who stated that learning mathematics is problematic for primary school pupils and that they experience many difficulties, especially in mathematical word-problems. These difficulties include; the language related to reading and understanding the content of the mathematical word-problems, interpretation of digits from verbal to symbolic states, selecting the appropriate mathematical operation for solving word-problems, and arriving at the correct solution to these problems. These results also confirm those of Ratanakul (1985) who stated that primary school pupils in Thailand experience many difficulties in solving mathematical word-problems. These difficulties include misunderstanding of mathematical word- problems for cultural reasons, the concurrent use of both traditional Thai numerals and Hindu-Arabic numerals and difficulty in understanding the context of the problem. *For 4th year primary school mathematics teachers' response frequencies in each option of the needs assessment questionnaire, and their percentages of the total number of teachers who responded, see table 35, appendix 6, p. 249.*

In fact, these conclusions are compatible with the common complaints among teachers as well as parents in the state of Kuwait that primary school pupils' main difficulties in solving word-problems are in these areas. For example, pupils often find it difficult to solve a given word-problem because they cannot read and understand its content or they cannot convert numbers from verbal to symbolic states.

The Training Programme

A programme for training 4th year primary pupils in solving mathematical word-problems was designed.

Description of the Programme

In designing the suggested programme, I took the following into account;

- ☒ Objectives of the programme
- ☒ Content of the programme
- ☒ Method of teaching the programme
- ☒ Evaluation.

Objectives of the Programme

Objectives of this programme were specified in the light of the analysis of the results of a needs assessment questionnaire. This questionnaire was used by me to identify the difficulties experienced by 4th year primary pupils in solving mathematical word-problems from primary school mathematics teachers' points of view, and thereby, diagnose their needs for mathematical word-problem training. Analysis of results indicated that there were five areas of difficulty experienced by 4th year primary pupils in solving mathematical word-problems in which they need training and direct instruction. These five areas of difficulty constituted the objectives that I intended to achieve. They were as follows:

(1) Developing 4th year primary pupils' performance in reading mathematical word-problems

(2) Developing 4th year primary pupils' performance in understanding word-problems

(3) Developing 4th year primary pupils' performance in converting digits in word-problems from verbal into symbolic forms

(4) Developing 4th year primary pupils' performance in determining the appropriate mathematical operation in word-problems

(5) Developing 4th year primary pupils' performance in arriving at the correct solution to word-problems.

Content of the Programme

In designing the content of the suggested programme, I have drawn on my long years of experience in teaching mathematics to primary school pupils. In addition, I benefited from the rich and informative view points of mathematics university professors and mathematics senior teachers and experts in the state of Kuwait. They helped me in selecting and deciding the kind of problems to be used in this programme and the way to introduce these problems to the pupils. Moreover, I benefited from the extensive review of literature and related evaluation studies (for example, by Barakaat, 1992; Al-Ghazo, 1994; Benko, 1999; Kousa, 1999; Roti et al., 2000; Al Sharbat & Khalil, 2001; Rajeh, 2002; Ebraheem, 2005). These studies gave me an insight into how programmes are designed and implemented.

The content of this programme was designed in the light of its specific objectives. It comprised ten lessons that were to cover the five (5) objectives of the programme. Each lesson includes some behavioural objectives and each two successive and interrelated lessons deal with a different area of difficulty in solving mathematical word-problems:

Lessons 1 & 2: Reading word-problems

Lessons 3 & 4: Understanding Word-problems

Lessons 5 & 6: Converting Digits from Verbal into Symbolic Form

Lessons 7 & 8: The Appropriate Choice of Mathematical Operation

Lessons 9 & 10: Arriving at the Appropriate Solution to Word-problems.

Methods of Teaching the Suggested Programme

Teaching the programme involved four stages; warm-up (follow-up and feedback), presentation, practice and evaluation:

1) Warm-up

Warm-up is carried out at the beginning of teaching the first lesson only. During teaching other lessons, warm-up turns into a follow-up and feedback session. The main purpose of this stage is to help pupils revise what they learnt during the previous lesson and to relate it to the upcoming lesson through a verbal activity undertaken by the more able pupils in front of their colleagues.

2) The presentation stage

The purpose of this stage is to introduce new material to the pupils. This is carried out using presentation methods such as lecturing, modelling and discussion.

3) The practice stage

In this stage, pupils have the opportunity to practice the material they learn with the teacher in every lesson. In order to help pupils become more independent and self-directed, as **Oxford (1990)** mentions, practice progresses from guided to free. This takes place through three types of activity; group work, whole-class work and individual work.

- **Group work**

Here, pupils are asked to form groups of five and to choose a spokesman for each group. Guided by the teacher, they are asked to do a certain activity or to finish an exercise related to the material studied in the lesson. Upon finishing, the spokesman in each group is asked to tell the whole class his group's answer and how they reach this answer. In this way, pupils are given opportunities to share their thinking.

- **Whole-class work**

In whole-class work, pupils are given additional opportunities for practice under the close supervision of the teacher. They are asked to do a certain activity or to finish an exercise related to the material studied.

- **Individual work**

During individual work, pupils work independently assuming greater responsibility for their own learning. They are asked to do a certain activity or to finish an exercise related to the material studied. When finished, they are asked, one at a time, to speak out their answers to the whole class and are supported by the teacher's corrective feedback.

4) The evaluation stage

Gronlund (1976: 6) states that, ‘Evaluation is a systematic process of determining the extent to which instructional objectives are achieved by pupils’. This means that the teacher should be alert to the extent to which learning outcomes are achieved. S/he should determine how far the pupils' progress and how far the activities used help achieve the previously identified instructional objectives.

Being essential for the whole process of teaching and learning, evaluation is dealt with in this programme as a methodological activity and as a continuous process. It is not delayed to the end of the programme. It is intended to provide pupils with opportunities to evaluate their own success in learning. This is achieved by asking the pupils to finish certain exercises throughout all the lessons in the suggested programme. These exercises are intended to evaluate pupils’ understanding of the presented material in each lesson. Upon finishing these exercises, pupils are given feedback on their answers by their teacher.

Evaluation of the programme

The whole programme was evaluated by means of a pre-post mathematical word-problem achievement test.

The Pre-post Mathematical Word-problem Achievement Test

According to Wharton (2007), achievement tests are usually related to a syllabus or set of objectives. Their purpose is to establish the level of pupil attainment *vis a vis* that syllabus or set of objectives. Achievement tests may be administered at the end of a course of study, or part-way through; in the latter case they of course have a formative function as well as an assessment function.

When people use the word *test,* in general, they mean ‘to appraise something or someone. That is, to test is to evaluate or measure something or someone against given criteria in order to obtain data that reveal relationships between our subject and our frame of reference’ (Louis & Marylin, 1978: 5). Thus a test is a tool for giving accurate, valid and reliable data that show the real character of someone or something. According to Gorsuch (1997), tests are perhaps best defined as socially accepted devices by which decisions can be made about individuals in relation to their position in education, and in society. Tests are the great gateways and the gatekeepers to social and economic accomplishment. For Broughton et al. (1980: 145), the word *test* means 'a carefully prepared measuring instrument, which has been tried out on a sample of people like those who will be assessed by it, which has been corrected and made as efficient and accurate as possible using the whole panoply of statistical techniques appropriate to educational measurement'. This means that designing a test is not haphazard; it needs much effort on the part of the test-developer. It needs careful preparation, correction and assessment by using appropriate statistical techniques, so that the test can be an accurate tool of measurement. For me, testing is a very sensitive and important process. It is upon the results of testing that important and decisive decisions are taken. Therefore, testing necessitates much careful and cautious effort in its preparation and administration.

Objectives of the Test

'Preparing a test obviously demands some knowledge of the subject with which the test is to be concerned' (Lewis & Aiken, 1976: 28). This means that clarifying objectives is an essential matter in designing a test. In the case of classroom tests, 'test objectives can be based directly on course objectives' (Harris, 1969: 1). The objectives of the present test are based on those of the programme. Therefore, the present test aims to measure the ability of 4th year primary school pupils to:

(1) Read mathematical word-problems

(2) Understand mathematical word-problems

(3) Convert digits in word-problems from verbal into symbolic forms

(4) Determine the appropriate mathematical operation needed for solving a given mathematical word-problem

(5) Arrive at the correct solution to mathematical word-problems.

Construction of the Test

The test developer must first determine the actual areas to be covered by his test (Heaton, 1988). In other words, determining the content to be covered by the test is a crucial matter in designing a test. This content, as pointed out by Harris (1969: 1), is 'derived from specific course content'. Hence, five main areas were specified to be measured by this test. Each area was dealt with in a separate part. The first area was about *reading mathematical word-problems,* which was measured by 10 items (1-10). In this part, children were asked to match items in two columns in order to form correct words. One mark was given to each correct item in this part, whereas two marks were given to each correct test item in the other parts of the test. Therefore, ten items not five were used to measure the reading of word-problems in this area. The second area was about *understanding mathematical word-problems,* which was measured by 5 items (11-15). The third area was about *converting digits in word-problems from verbal into symbolic forms,* which was measured by 5 items (16-20). And the fourth area was about *determining the appropriate mathematical operation needed for solving a given mathematical word-problem,* which was measured by 4 items (21-24). Four items were decided on to measure the four mathematical operations, namely multiplication, subtraction, addition and division. The fifth and last area was about *arriving at the correct solution to mathematical word-problems*, which was measured by 6 items (25-30). In this part, children were asked to read the given word-problems, and then choose the correct solutions for these problems. In solving these problems, children need to use all of the above measured abilities. As a result, six items were decided on to measure this area because of its relative importance. Thus, the test included 30 items, in five parts, each one of which requires one (1) correct answer. For more details, see appendix 4, P. 226.

Item Type

According to Brown (1994), an item is any opportunity for pupils to give an answer or provide information which will have some affect on their test score (as cited in Gorsuch, 1997). However, 'no one can write good test items the first time around, not even experienced, professional test item writers' (Brown, 1994, as cited in Gorsuch & Dale, 1997). For this reason, a test developer 'should plan quite a few more items that he actually will use, because he is probably going to throw some of them away' (Gorsuch & Dale, 1997). For me, this was very true; the test developer should write more test items than required in order to give the panel of jurors a chance to select the best items for the purpose of testing validity.

Drawing on this, the preliminary version of this test included more than 40 items. Upon showing the test to the same panel of jurors, they advised me to omit some items and to modify others. The test in its final form included 30 items.

The test items were of two different formats; matching and multiple choice. All items in part one of the test (1-10) were of the matching format. In this part of the test, the pupil was asked to match each item in column (a) with the suitable one from column (b) in order to form correct words. All items in the other parts of the test (11-30) were designed in a multiple choice format. Each item included a stem followed by four alternatives or options. Only one of these alternatives was the correct option while the other three were distractors or incorrect options. 'Distractors should be reasonably attractive and plausible. Items should be constructed in such a way that pupils obtain the correct option by direct selection rather than by the elimination of obviously incorrect options' (Heaton, 1975: 19). Drawing on Heaton's recommendation, distractors were made good-looking, believable, clear, and grammatically correct when each stood by itself.

Test Validity

According to Hubbell, (2003: 12), Bachman states that 'the most difficult and important concept in testing is that of validity. The reason this is so difficult, I think, is that you can't really get a handle on it without facing many complexities and conundrums'. Bachman mentioned some examples of these complexities among which are the following;

A. If we accept the possibility that different test takers respond differently to the same test task, often for different reasons, then does this mean that this task measures different constructs for different test takers?

B. If we change only one or two characteristics of a particular test task, we may find that this dramatically changes the way some test takers respond to it. How does this affect the kinds of inferences we can make on the basis of performance on this task?

C. If different groups of individuals (e.g., men, women, and users of different L1s) perform differently on the same test task, what does this say about the inferences we can make? How does this affect the decisions we make on the basis of their performance? How fair will these decisions be?

Johnson (1977: 108) states that 'A test or other measuring instrument is valid to the extent it measures what it is intended to measure'. That is to say, the most important question a test-writer has to ask is, to what extent will the results of the test serve the particular uses for which they are intended? In other words, the validity of a test depends on the content of its items and how the scores are used. According to Gorsuch (1997), for a test to be valid, educators are required to have a thorough understanding of what pupils are being asked to do in the test, and a thorough understanding of the thing (trait) within the pupils being measured - for a test to be valid, these two understandings must be matched. Confirming this, I see that a test developer must be well aware of what he is doing. He must know exactly what is required from the testees on taking his test. Most importantly, he must be aware of the objectives of his test and the very particular thing he is measuring in his test takers.

Content Validity

According to Lewis (1999: 6), content or face validity is 'the degree with which a test or questionnaire appears to be appropriate for its intended purpose, based on simple inspection of the test or questionnaire itself'. A test developer should obtain item feedback by giving his test items to colleagues to check that (a) the items make sense; (b) there is not more than one possible correct answer; (c) there are no spelling or grammatical errors; and (d) that the correct answer to one item is not inadvertently being given to pupils in, say, another item. He should ask his colleagues for their opinion on whether his items are valid (Gorsuch & Dale, 1997).

Drawing on this recommendation, the test was shown to a panel of mathematics experts and specialists, (see appendix 1, p. 214), to make sure of its content and face validity. The panel members made their comments which I took into consideration. In the light of their comments, some changes and modifications were made in both content and wording of the test. For example, part one of the test comprised only five items in the preliminary version of the test. The panel members suggested adding five more items to this part. As a result, part one of the test comprised ten items not five in the final version of the test.

In the preliminary version of the test, each item of the multiple choice formatted questions included a stem followed by three choices. The panel members suggested adding one more to the three choices under each stem.

Consequently, each of the multiple choice formatted items included a stem followed by four alternatives or choices in the final version of the test.

Having the necessary changes and modifications made, the test was re-shown to the same panel the majority of which pointed out that the test was a valid instrument.

Test Reliability

According to Lewis (1999: 3), 'the term reliability refers to the degree with which repeated measurements, or measurements taken under identical circumstances, will yield the same results'. This definition assumes that the process of measurement does not affect the variable or characteristic of interest. For Gronlund (1976: 93), 'Reliability refers to the consistency of measurement—that is, to how consistent test scores or other evaluation results are from one measurement to another'.

The reliability of the present test was estimated by administering it, in two separate sessions to a group of thirty (30) 4th year primary school pupils who were not included in the main study sample and who were used only as a pilot study sample. Then, Cronbach Alpha was used to check the reliability and internal consistency of the composite variables using SPSS. The reliability of the test was found (r=.898). This indicates that the items are correlated and address the research problem. *For the raw scores of the pupils of the pilot study sample in the two administrations of the pre-post mathematics achievement test, which were used to calculate its reliability,* *see table 69, appendix 6, p. 289.*

Reliability Statistics

Cronbach's Alpha	N. of Variables
.898	2

Such a result is considered a reasonable value for classroom tests. As Lewis (1999: 5) states, 'although the desired reliability depends on the intended use of the measurement, a measurement, in general, is considered reliable if $r > 0.80$'.

Test Administration

Administering this test involved the following steps;

Announcing the test

It is essential that testees know well in advance when a test will be administered and with what content it will be concerned. Drawing on this, testees are informed about the time, the place and the content of the test.

Proper Testing Conditions

Experts in testing have come to agree that the test administrator must make certain that seating, lighting, ventilation, temperature and other physical conditions are satisfactory. A room that is moderately free from noise and other distractions is especially important. Whenever possible it is preferable to give the test in a classroom familiar to the examinees. Given the opportunity of teaching in some primary schools in Kuwait, I did not face any problem with respect to this point. Therefore, a suitable room was assigned in each school of the two schools chosen for the study, for the administration of both the test and the programme.

Test Directions

It is a well-known fact that if the instructions of a test are not clear, for whatever reason, the results are not valid. In addition, test directions should tell the testees what they are supposed to do and how long they have in which to do it. More specifically, the directions should indicate in relatively simple language the purpose of the test, the time limits, the method of recording answers and the way the test is to be scored. Bearing in mind that clarity and simplicity are crucial and indispensable in writing test directions, the directions of the test used in this study are written in clear and simple language. Every testee was given a sheet of directions which s/he was asked to read for five minutes before the test began.

Moreover, to ensure that the test directions are fully understood, the directions are discussed orally with the testees. Test directions provide testees with information on what they are supposed to do, duration of the test and test items.

Test Duration

Heaton (1975: 158) states, 'the time to be allowed should be decided on as a result of a pilot administration of the test (i.e. a try-out of the test to a small but representative group of testees)'. Drawing on Heaton's recommendation, the test was tried out on a group of (20) 4th year primary school pupils taken from the thirty-pupil pilot study sample who were not included in the main sample of the study. The result of this pilot administration indicated that a session of 45 minutes was enough to complete the test. In addition, the panel of experts who judged the instrument pointed out that 45 minutes was quite enough to complete the test. On the basis of the result of the pilot administration and the recommendations of the panel of jurors, it was decided that forty five minutes was the optimum time for completing the test.

Scoring the Test

The test was scored easily by me; one mark was given for each correct answer and a zero for each incorrect answer in part one of the test. In the other parts, two marks were given for each correct answer and a zero for each incorrect one. The maximum score for this test was 50 marks.

Thus, the test was administered to the subjects of the study as a pre-test to measure their performance on solving mathematical word-problems.

Implementation of the programme

Before implementing the suggested programme, I showed it to the same panel of jurors. They made their modifications and suggested changes which I then carried out. For example, in the preliminary version, the programme, comprised only five lessons to cover the five (5) objectives of the programme. Upon showing it to the panel of jurors, they suggested adding one more lesson to each area of difficulty in order to give the children a better opportunity to practice in that area. Consequently, the programme in its final version comprised ten lessons instead of five; each area of difficulty was dealt with in two successive interrelated lessons.

After that, I administered two lessons of the programme to the subjects of the pilot study sample as a pilot study. I did so in order to make sure of the suitability of the programme's objectives, content, method of teaching and the time allotted to each lesson. After teaching those lessons to the subjects of the pilot study sample, I made the necessary modifications until I was fully convinced of the suitability and validity of the programme for the 4th year primary school pupils. Among those changes, some practice exercises were deleted from lessons one and two because during the pilot administration, it was seen that some of these exercises were redundant and that 45 minutes were not enough for teaching each of these lessons.

Teaching the programme lasts about 5 weeks; two lessons per week. Each lesson was taught in forty five minutes. That is to say, the total time of implementing the suggested programme is eight (8) hours.

Mathematical Word-problem Attitude Scale

A scale for identifying 4th year primary school pupils' attitudes towards mathematical word-problems before and after studying the suggested programme was prepared by me. This scale was administered to the experimental group pupils before and after receiving training on solving mathematical word-problems through the suggested programme.

The scale used was a 24-item, 5-point Likert-scale (strongly agree – agree - undecided – disagree - strongly disagree). The scale is aimed at identifying 4th year primary school pupils' attitudes towards mathematical word-problems before and after studying the suggested programme.

This instrument was developed on the assumption that an important consequence of instruction is a change in the pupil's feelings toward the subject matter they study, and I assume that there usually exists a positive correlation between feelings and achievement. The scale was not intended to measure absolute feelings toward mathematical word-problems; rather, it was designed to detect and measure changes in feelings about mathematical word-problems generally from the beginning and end of the suggested programme.

To construct the present scale, I reviewed related literature and available studies that used attitude scales as study instruments. This review gave me an insight into the way in which attitude scales are constructed, administered and analyzed. At the same time, I informally met some mathematics experts as well as numbers of university faculties and researchers in Kuwait. They provided me with insight into how attitudes are measured. Furthermore, I made use of my nine-year experience of teaching at the primary stage in Kuwait. Thus, by reviewing related literature and available studies, live observation and meetings with faculty members as well as mathematics experts, I built a list of statements from which I constructed the content of this scale.

In this scale, 4th year primary school pupils are asked to choose the options that best describe their feelings towards the mathematical word-problems.

Having in mind the age of the respondents and their reading ability, I tried to make the language of the scale simple, specific, free of bias, not patronizing, technically accurate and appropriate to their level.

Validity of the Scale

In very broad terms**,** Aneshensel (2004: 14) states that **'**validity means the extent to which a measure assesses that which it purports to measure'. In other words, a scale is valid to the extent to which its items measure what they are intended to measure.

Content Validity

The scale was shown to the same panel of jurors who judged the instruments of this study (see appendix 1, p. 214). The panel of jurors made their comments concerning the stating of the scale's items, formatting of the scale, fitness to the group of the study and the extent to which the scale's items measure what I intend to measure.

In the light of the comments of the panel of jurors, some modifications to the primary form of the scale were made. These modifications included deleting and rephrasing some statements of the scale. For example, in the preliminary version of the scale, statement number three said *I hate mathematical word-problems all the time*, and the panel of jurors suggested rephrasing it to read *I am always under a terrible strain in a mathematical word-problem class*. In another example, in the preliminary version of the scale, statement number twenty-four said *my solutions to word-problems are always wrong*, but the panel of jurors suggested rephrasing it to read *I always feel suspicious about my solutions to mathematical word-problems*.

Reliability of the Scale

According to Alderson, Clapham & Wall (1995: 6) 'reliability is the extent to which test scores are consistent: if candidates took the same test again tomorrow after taking it today, would they get the same result?' (Cited in Gorsuch 1997). I assembled thirty (30) 4th year primary school pupils taken from the thirty-pupil pilot study sample who were not included in the main sample of the study. After acquainting them with the objectives of the scale and how to respond to its items, I asked them to respond to these items.

When the 30 pupils had finished responding to the scale's items, I collected them in. Then, I rated them and kept a record of the pupils' scores. After approximately a month, the exercise was repeated. After that, Cronbach Alpha was used to check the reliability and internal consistency of the composite variables of the scale. Through SPSS, the reliability of the scale was found (r=.936), and this indicated that the scale enjoys a high level of reliability. *For the raw scores of the pupils of the pilot study sample in the two administrations of the attitude scale, which were used to calculate its reliability, see tables 70 and 71, appendix 6, p. 290-291.*

Reliability Statistics

Cronbach's Alpha	N. of Variables
.936	2

Content of the Scale

The scale, in its final form included twenty four statements. There were five options alongside each statement. The pupil had to choose either 'a', 'b', 'c', 'd', or 'e', where 'a' indicates that the pupil strongly agrees with the given statement, 'b' indicates that the pupil agrees but not so strongly, 'c' indicates that the pupil is not sure about the given statement or s/he cannot rate it, 'd' indicates that the pupil disagrees, but not so strongly, and 'e' indicates that the pupil strongly disagrees with the given statement. For more details, see appendix 5, p. 241.

Scoring the Scale

As mentioned before, the scale used here is a 5-point Likert-scale. In scoring positive items or statements in this scale, five marks are given to point (A), four marks are given to point (B), three marks are given to point (C), two marks are given to point (D), and one mark is given to point (E). On the other hand, in scoring negative items or statements in this scale, one mark is given to point (A), two marks are given to point (B), three marks are given to point (C), four marks are given to point (D), and five mark are given to point (E).

The score of any statement in this scale is the score resultant from multiplying the number of responses by the value given to the respective point of the scale and the maximum score for any statement is the score resultant from multiplying the total number of subjects by the value given to the respective point in the scale.

Administration of the Scale

I administered the scale to the experimental group pupils in order to identify their attitudes towards mathematical word-problems before implementing the suggested programme. Bearing in mind the age of the respondents and their reading level, the directions for the scale used were written in clear and simple language. Every respondent was given a sheet of directions, which s/he was asked to read for five minutes before the administration of the scale.

To ensure that the scale's directions were fully understood, they were discussed orally with the respondents. Moreover, the items were read slowly to them before they began work.

Comment

Measuring pupils' attitudes towards certain subjects is of great importance for teachers and curriculum developers. It enables them to anticipate general views and opinions in order for them to take decisions and to deal with recent problems in the educational field in general. It is also considered to be one of the important direct channels of communication between pupils and their teachers. Hence, I intended to use the present scale for measuring 4^{th} year primary school pupils' attitudes towards mathematical word-problems before and after teaching them my suggested programme.

Ethical Processes

In conducting the present study, I took some ethical considerations into account. Written approval letters were sent to directors of the selected schools to take their permission for conducting this study on some selected classrooms in their schools. Before applying the mathematical word-problem diagnostic test for identifying pupils' difficulties with word-problems, an approval letter was sent to the parents of the participating pupils to take their permission for applying this test on their children.

An e-mail was sent to every one of the primary school mathematics teachers participating in this study to take his/her permission to complete the needs assessment questionnaire of the study. Permission to administer the pre-post mathematical word-problem achievement test and the mathematical word-problem attitude scale was taken from all parents of the pupils participating in this study.

Before teaching the suggested programme, an approval letter was sent to the parents of the experimental group pupils in the two schools; Hisham Ibn Omayaa primary school for boys and Lobaba Bint Al-haareth primary school for girls. Via this letter, permission was taken from parents to teach the suggested program to their children. In addition, pupils were informed that this programme and the pre-post tests have no relation with their final exams and the scores obtained from these tests have no relation with their final scores and they are used only for the sake of evaluating the suggested program. Moreover, participating pupils were reminded from time to time that their participation in this study was voluntary and they had the right to withdraw when they chose.

Summary

In this chapter, a detailed description of the sample, the variables, the instruments and the design used in experimentation was given. It is made clear that this study was conducted on primary school pupils in the state of Kuwait and it used 100 4th year primary school pupils as its subjects. It is also made clear that the study used a pre-post control group design in experimentation. Instruments used included a pre-post mathematical word-problem achievement test, a pre-post mathematical word-problem attitude scale, and a mathematical word-problem programme. The chapter gives a very detailed and meticulous description of the procedures used in preparing, standardizing and administering these instruments.

CHAPTER FOUR

RESULTS

Introduction

At the end of the research the mathematical word-problem achievement test was re-administered to the subjects of the study in order to measure the effect of the suggested programme on their performance when solving mathematical word-problems.

To measure the effect of the suggested programme on 4th year primary school pupils' attitudes towards mathematical word-problems, the attitude scale was re-administered to the subjects of the experimental group when teaching of the suggested programme had finished.

Then, a "t" test for small samples was used to analyze the differences between means of scores of the study subjects in the pre and the post-measurements.

This chapter presents the results obtained. Scores of the control group pupils and those of the experimental group were compared in the pre and the post measurements. Results of comparisons revealed a significant improvement in 4th year primary school pupils' performance in solving mathematical word-problems and in their attitudes towards word-problems in general.

(1) Pre-post Mathematical Word-problem Achievement Test Results:

(1.1) Testing Hypothesis One

"There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-test of the mathematical word-problem".

Table (4)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Pre-Test of Mathematical Word-problem

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control	50	22.8000	2.962	49	-.86	No Significance
Experimental	50	23.2800	3.044			

Table (4) shows a comparison of the scores of the subjects of the control and experimental groups in the pre mathematical word-problem achievement test. There is no statistically significant difference between means of scores obtained by subjects of the control and experimental groups in the pre-test. Control group subjects achieved a mean score of **22.8000** whereas the mean score of the experimental group subjects was **23.2800**. The "t" value **-.86** reveals no statistically significant difference between mean scores of the subjects of the two groups on the pre-test. Thus, the first hypothesis is affirmed. *For the raw scores of the control group pupils and those of the experimental group in the pre mathematical word-problem achievement test, see tables (36 & 42), appendix (6), pages (250 & 256).*

<u>(1.2) Testing the Five Sub-hypotheses of Hypothesis One</u>

The five sub-hypotheses of hypothesis one stipulated that "There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-testing of reading the content of the mathematical word-problems, understanding the content of the mathematical word-problems, converting digits from verbal to symbolic forms in mathematical word-problems, choosing the appropriate mathematical operations, and in the arrival at the correct solution to the mathematical word-problems".

Table (5)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Pre-Test of Reading and Understanding the Content of the Mathematical Word-problems, Converting Digits from Verbal to Symbolic Forms in Mathematical Word-Problems, Choosing the Appropriate Mathematical Operations, and in Arriving at the Correct Solution to the Mathematical Word-Problems

Test Parts	N	Control Group		Experimental Group		t-value	Degree of Freedom (df.)	Significance
		Mean Score	SD	Mean Score	SD			
One	50	5.0400	1.142	5.1200	1.256	-.32	49	No Significance
Two		4.4800	1.374	4.5200	1.657	-.12		
Three		4.4400	1.296	4.5600	1.402	-.53		
Four		3.5600	1.358	3.6400	1.191	-.32		
Five		5.3200	1.039	5.4000	1.355	-.32		

Table (5) shows a comparison of the scores of the subjects of the control and experimental groups in the five parts of the pre mathematical word-problem achievement test. There are no statistically significant differences between means of scores obtained by subjects of the control and experimental groups in the pre-test. In part one, which is related to reading the content of the mathematical word-problems, control group subjects achieved a mean score of **5.0400** whereas the mean score of the experimental group subjects was **5.1200**. The "t" value (**-.32**) reveals no statistically significant difference between mean scores of the subjects of the two groups. In part two, which is related to understanding the content of the mathematical word-problems, control group subjects achieved a mean score of 4.4800 whereas the mean score of the experimental group subjects was 4.5200. The "t" value (-.12) reveals no statistically significant difference between mean scores of the subjects of the two groups. In part three, which is related to converting digits from verbal to symbolic forms in mathematical word-problems, control group subjects obtained a mean score of 4.4400 whereas the mean score of the experimental group subjects was 4.5600. The "t" value (-.53) reveals no statistically significant difference between mean scores of the subjects of the two groups. In part four, which is related to choosing the appropriate mathematical operations, control group subjects achieved a mean score of 3.5600 whereas the mean score of the experimental group subjects was 3.6400. The "t" value (-.32) reveals no statistically significant difference between mean scores of the subjects of the two groups. And in part five, which is related to arriving at the correct solutions to the mathematical word-problems, control group subjects obtained a mean score of 5.3200 whereas the mean score of the experimental group subjects was 5.4000. The "t" value (-.32) reveals no statistically significant difference between mean scores of the subjects of the two groups. Thus, the five sub-hypotheses of hypothesis one are affirmed.

(1.3) Testing Hypothesis Two

"There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-test of the mathematical word-problem".

Table (6)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Pre-Test of Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Boys	25	22.7600	2.990	24	-.47	No Significance
Experimental Group Boys	25	23.1600	3.132			

Table (6) shows a comparison of the scores of the boys of the control group and those of the experimental group in the pre mathematical word-problem achievement test. There is no statistically significant difference between means of scores obtained by the boys of the control group and those of the experimental group in the pre-test. Control group boys obtained a mean score of **22.7600** whereas the mean score of the experimental group boys was **23.1600**. The "t" value (**-.47**) reveals no statistically significant difference. Thus, the second hypothesis is affirmed. *For the raw scores of the control group boys and those of the experimental group in the pre mathematical word-problem achievement test, see tables (36 & 42), appendix (6), pages (250 & 256).*

(1.4) Testing the Five Sub-hypotheses of Hypothesis Two

The five sub-hypotheses of hypothesis two stipulated that "There is no statistically significant difference between the means of scores obtained by the boys of the control group and those of the experimental group in the pre-testing of reading the content of the mathematical word-problems, understanding the content of the mathematical word-problems, converting digits from verbal to symbolic forms in mathematical word-problems, choosing the appropriate mathematical operations, and in the arrival at the correct solution to the mathematical word-problems".

Table (7)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Pre-Test of Reading and Understanding the Content of the Mathematical Word-problems, Converting Digits from Verbal to Symbolic Forms in Mathematical Word-Problems, Choosing the Appropriate Mathematical Operations, and in Arriving at the Correct Solution to the Mathematical Word-Problems

Test Parts	N	Control Group Boys		Experimental Group Boys		t-value	Degree of Freedom (df.)	Significance
		Mean Score	SD	Mean Score	SD			
One	25	5.0000	1.080	4.9200	1.288	.23	24	No Significance
Two		4.4000	1.414	4.5600	1.873	-.29		
Three		4.4800	1.327	4.6400	1.381	-.53		
Four		3.5200	1.327	3.6800	1.249	-.49		
Five		5.4400	1.083	5.2800	1.275	.49		

Table (7) shows a comparison of the scores of the boys of the control and experimental groups in the five parts of the pre mathematical word-problem achievement test. There are no statistically significant differences between means of scores obtained by boys of the control and experimental groups in the pre-test. In part one, which is related to reading the content of the mathematical word-problems, control group boys achieved a mean score of 5.0000 whereas the mean score of the experimental group boys was 4.9200. The "t" value (.23) reveals no statistically significant difference between mean scores of the boys of the two groups. In part two, which is related to understanding the content of the mathematical word-problems, control group boys obtained a mean score of 4.4000 whereas the mean score of the experimental group boys was 4.5600. The "t" value (-.29) reveals no statistically significant difference between mean scores of the boys of the two groups. In part three, which is related to converting digits from verbal to symbolic forms in mathematical word-problems, control group boys achieved a mean score of 4.4800 whereas the mean score of the experimental group boys was 4.6400. The "t" value (-.53) reveals no statistically significant difference between mean scores of the boys of the two groups. In part four, which is related to choosing the appropriate mathematical operations, control group boys obtained a mean score of 3.5200 whereas the mean score of the experimental group boys was 3.6800. The "t" value (-.49) reveals no statistically significant difference between mean scores of the boys of the two groups. And in part five, which is related to arriving at the correct solutions to the mathematical word-problems, control group boys achieved a mean score of 5.4400 whereas the mean score of the experimental group boys was 5.2800. The "t" value (.49) reveals no statistically significant difference between mean scores of the boys of the two groups. Thus, the five sub-hypotheses of hypothesis two are affirmed.

(1.5) Testing Hypothesis Three

"There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-test of the mathematical word-problem".

Table (8)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Pre-Test of Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control Group Girls	**25**	**22.8400**	**2.996**	**24**	**-.76**	**No Significance**
Experimental Group Girls	**25**	**23.4000**	**3.014**			

Table (8) shows a comparison of the scores of the girls of the control group and those of the experimental group in the pre mathematical word-problem achievement test. There is no statistically significant difference between means of scores obtained by the girls of the control group and those of the experimental group in the pre-test. Control group girls achieved a mean score of **22.8400** whereas the mean score of the experimental group girls was **23.4000**. The "t" value (**-.76**) reveals no statistically significant difference. Thus, the third hypothesis is affirmed. *For the raw scores of the control group girls and those of the experimental group in the pre mathematical word-problem achievement test, see tables (36 & 42), appendix (6), pages (250 & 256).*

(1.6) Testing the Five Sub-hypotheses of Hypothesis Three

The five sub-hypotheses of hypothesis three stipulated that "There is no statistically significant difference between the means of scores obtained by the girls of the control group and those of the experimental group in the pre-testing of reading the content of the mathematical word-problems, understanding the content of the mathematical word-problems, converting digits from verbal to symbolic forms in mathematical word-problems, choosing the appropriate mathematical operations, and in the arrival at the correct solution to the mathematical word-problems".

Table (9)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Pre-Test of Reading and Understanding the Content of the Mathematical Word-problems, Converting Digits from Verbal to Symbolic Forms in Mathematical Word-Problems, Choosing the Appropriate Mathematical Operations, and in Arriving at the Correct Solution to the Mathematical Word-Problems

Test Parts	N	Control Group Girls		Experimental Group Girls		t-value	Degree of Freedom (df.)	Significance
		Mean Score	SD	Mean Score	SD			
One	25	5.0800	1.222	5.3200	1.215	-.68	24	No Significance
Two		4.5600	1.356	4.4800	1.447	.19		
Three		4.4000	1.291	4.4800	1.447	-.24		
Four		3.6000	1.414	3.6000	1.155	.00		
Five		5.2000	1.000	5.5200	1.447	-.85		

Table (9) shows a comparison of the scores of the girls of the control and experimental groups in the five parts of the pre mathematical word-problem achievement test. There are no statistically significant differences between means of scores obtained by girls of the control and experimental groups in the pre-test. In part one, which is related to reading the content of the mathematical word-problems, control group girls obtained a mean score of **5.0800** whereas the mean score of the experimental group girls was **5.3200**. The "t" value (**-.68**) reveals no statistically significant difference between mean scores of the girls of the two groups. In part two, which is related to understanding the content of the mathematical word-problems, control group girls achieved a mean score of **4.5600** whereas the mean score of the experimental group girls was **4.4800**. The "t" value (**.19**) reveals no statistically significant difference between mean scores of the girls of the two groups. In part three, which is related to converting digits from verbal to symbolic forms in mathematical word-problems, control group girls obtained a mean score of **4.4000** whereas the mean score of the experimental group girls was **4.4800**. The "t" value (**-.24**) reveals no statistically significant difference between mean scores of the girls of the two groups. In part four, which is related to choosing the appropriate mathematical operations, control group girls obtained a mean score of **3.6000** whereas the mean score of the experimental group girls was **3.6000**. The "t" value (**.00**) reveals no statistically significant difference between mean scores of the girls of the two groups. And in part five, which is related to arriving at the correct solutions to the mathematical word-problems, control group girls achieved a mean score of **5.2000** whereas the mean score of the experimental group girls was **5.5200**. The "t" value (**-.85**) reveals no statistically significant difference between mean scores of the girls of the two groups. Thus, the five sub-hypotheses of hypothesis three are affirmed.

(1.7) Testing Hypothesis Four

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-test of the mathematical word-problem".

Table (10)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Post-Test of Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control	50	22.9400	2.766	49	-17.31	0.01
Experimental	50	34.4000	3.194			

Table (10) shows a comparison of the scores of the subjects of the control and experimental groups in the post administration of the mathematical word-problem achievement test. Comparisons are in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**34.4000)** in the post-test than that obtained by the control group (**22.9400)**. The "t" value (**-17.31**) reveals a highly significant difference between means of scores of the control and experimental group subjects on the post test. Thus, the fourth hypothesis is affirmed. *For the raw scores of the control group pupils and those of the experimental group on the post mathematical word-problem achievement test, see tables (48 & 54), appendix (6), pages (262 & 268).*

<u>(1.7.1)</u> <u>Testing the First Sub-hypothesis of Hypothesis Four</u>

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of reading the content of the mathematical word-problem".

Table (11)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Post-Test of Reading the Content of the Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control	50	4.9800	1.204	49	-9.41	0.01
Experimental	50	7.0000	.670			

Table (11) shows a comparison of the scores of the subjects of the control and experimental groups in part one of the post mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problem. Comparisons are in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**7.0000**) in the post-test than that obtained by the control group (**4.9800**). The "t" value (**-9.41**) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. Thus, the first sub-hypothesis of hypothesis four is affirmed.

(1.7.2) Testing the Second Sub-hypothesis of Hypothesis Four

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-testing of understanding the content of the mathematical word-problem".

Table (12)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Post-Test of Understanding the Content of the Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control	50	4.5600	1.280	49	-9.97	0.01
Experimental	50	6.8400	.997			

Table (12) shows a comparison of the scores of the subjects of the control and experimental groups in part two of the post-mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problem. Comparisons are in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**6.8400**) in the post-test than that obtained by the control group (**4.5600**). The "t" value (**-9.97**) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. Thus, the second sub-hypothesis of hypothesis four is affirmed. *For the raw scores of the control group pupils and those of the experimental group in part two of the post mathematical word-problem achievement test, see tables (50 & 56), appendix (6), pages (264 & 270).*

<u>(1.7.3)</u> <u>Testing the Third Sub-hypothesis of hypothesis Four</u>

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group

and those of the experimental group in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems".

Table (13)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Post-Test of Converting Digits from Verbal to Symbolic Forms in the Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control	**50**	**4.5200**	**1.199**	**49**	**-11.00**	**0.01**
Experimental	**50**	**7.0000**	**1.161**			

Table (13) shows a comparison of the scores of the subjects of the control and experimental groups in part three of the post-mathematical word-problem achievement test, which is related to converting digits from verbal to symbolic forms in the mathematical word-problems. Comparisons are in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**7.0000**) in the post-test than that obtained by the control group (**4.5200**). The "t" value **(-11.00**) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. Thus, the third sub-hypothesis of hypothesis four is affirmed.

(1.7.4) Testing the Fourth Sub-hypothesis of Hypothesis Four

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group

and those of the experimental group in the post-testing of the choice of appropriate mathematical operation in word-problems".

Table (14)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Post-Test of the Choice of Appropriate Mathematical Operation

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control	**50**	**3.6400**	**1.120**	**49**	**-7.77**	**0.01**
Experimental	**50**	**5.6000**	**1.278**			

Table (14) shows a comparison of the scores of the subjects of the control and experimental groups in part four of the post-mathematical word-problem achievement test, which is related to choosing the appropriate mathematical operation in solving the mathematical word-problems. Comparisons are in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**5.6000**) in the post-test than that obtained by the control group (**3.6400**). The "t" value **(-7.77**) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. Thus, the fourth sub-hypothesis of hypothesis four is affirmed.

(1.7.5) Testing the Fifth Sub-hypothesis of Hypothesis Four

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group

and those of the experimental group in the post-testing of arrival at the correct solution to the word-problems".

Table (15)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Control Group and those of the Experimental Group in the Post-Test of Arriving at the Correct Solution to the mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control	**50**	**5.2400**	**1.205**	**49**	**-10.96**	**0.01**
Experimental	**50**	**8.0400**	**1.428**			

Table (15) shows a comparison of the scores of the subjects of the control and experimental groups in part five of the post-mathematical word-problem achievement test, which is related to arriving at the correct solution to the mathematical word-problems. Comparisons are in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**8.0400**) in the post-test than that obtained by the control group (**5.2400**). The "t" value **(-10.96**) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. Thus, the fifth sub-hypothesis of hypothesis four is affirmed.

(1.8) Testing Hypothesis Five

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-test of the mathematical word-problem".

Table (16)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Post-Test of Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control Group Boys	**25**	**23.0000**	**2.944**	**24**	**-11.46**	**0.01**
Experimental Group Boys	**25**	**33.6800**	**2.719**			

Table (16) shows a comparison of the scores of the boys of the control group and those of the experimental group in the post administration of the mathematical word-problem achievement test. Comparisons are in favour of the experimental group boys. The mean score of the experimental group boys in the post-mathematical word-problem achievement test is significantly higher than that of the boys of the control group. Experimental group boys achieved a higher mean (**33.6800**) in the post-test than that obtained by those of the control group (**23.0000**). The "t" value (**-11.46**) reveals a highly significant difference between means of scores of the boys of the two groups in the post test. Thus, the fifth hypothesis is affirmed. *For the raw scores of the control group boys and those of the experimental group on the post mathematical word-problem achievement test, see tables (48 & 54), appendix (6), pages (262 & 268).*

(1.8.1) Testing the First Sub-hypothesis of Hypothesis Five

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of reading the content of the mathematical word-problem."

Table (17)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Post-Test of Reading the Content of the Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of significance
Control Group Boys	25	4.9200	1.352	24	-6.36	0.01
Experimental Group Boys	25	6.8800	.600			

Table (17) shows a comparison of the scores of the boys of the control group and those of the experimental group in part one of the post mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problem. Comparisons are in favour of the experimental group boys. The mean score of the experimental group boys in the post-mathematical word-problem achievement test is significantly higher than that of the boys of the control group. Experimental group boys achieved a higher mean (**6.8800**) in the post-test than that obtained by those of the control group (**4.9200**). The "t" value (**-6.36**) reveals a highly significant difference between means of scores of the boys of the two groups in the post test. Thus, the first sub-hypothesis of hypothesis five is affirmed.

(1.8.2) Testing the Second Sub-hypothesis of Hypothesis Five

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of understanding the content of the mathematical word-problem."

Table (18)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Post-Test of Understanding the Content of the Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Boys	25	4.4800	1.327	24	-6.57	0.01
Experimental Group Boys	25	6.8800	1.013			

Table (18) shows a comparison of the scores of the boys of the control group and those of the experimental group in part two of the post-mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problem. Comparisons are in favour of the experimental group boys. The mean score of the experimental group boys in the post-mathematical word-problem achievement test is significantly higher than that of the boys of the control group. Experimental group boys achieved a higher mean (**6.8800**) in the post-test than that obtained by those of the control group (**4.4800**).

The "t" value (**-6.57**) reveals a highly significant difference between means of scores of the boys of the two groups in the post test. Thus, the second sub-hypothesis of hypothesis five is affirmed.

<u>(1.8.3) Testing the Third Sub-hypothesis of Hypothesis Five</u>

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems."

Table (19)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Post-Test of Converting Digits from Verbal to Symbolic form in the Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Boys	25	4.5600	1.227	24	-7.35	0.01
Experimental Group Boys	25	6.9600	1.020			

Table (19) shows a comparison of the scores of the boys of the control group and those of the experimental group in part three of the post-mathematical word-problem achievement test, which is related to converting digits from verbal to symbolic form in the word-problems. Comparisons are in favour of the experimental group boys. The mean score of the experimental group boys in the post-mathematical word-problem achievement test is significantly higher than that of the boys of the control group. Experimental group boys achieved a higher mean (**6.9600**) in the post-test than that obtained by those of the control group (**4.5600**).The "t" value (**-7.35**) reveals a highly significant difference between means of scores of the boys of the two groups on the post test. Thus, the third sub-hypothesis of hypothesis five is affirmed.

(1.8.4) Testing the Fourth Sub-hypothesis of Hypothesis Five

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of choice of appropriate mathematical operation in word-problems."

Table (20)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Post-Test of Choosing the Appropriate Mathematical Operation in Solving Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Boys	25	3.6800	1.108	24	-5.06	0.01
Experimental Group Boys	25	5.5200	1.194			

Table (20) shows a comparison of the scores of the boys of the control group and those of the experimental group in part four of the post-mathematical word-problem achievement test, which is related to choosing appropriate mathematical operations in solving word-problems. Comparisons are in favour of the experimental group boys. The mean score of the experimental group boys in the post-mathematical word-problem achievement test is significantly higher than that of the boys of the control group. Experimental group boys achieved a higher mean (**5.5200**) in the post-test than that obtained by those of the control group (**3.6800**). The "t" value (**-5.06**) reveals a highly significant difference between means of scores of the boys of the two groups in the post test. Thus, the fourth sub-hypothesis of hypothesis five is affirmed.

(1.8.5) Testing the Fifth Sub-hypothesis of Hypothesis Five

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the boys of the control group and those of the experimental group in the post-testing of arrival at the correct solution to the word-problems.**"**

Table (21)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Boys of the Control Group and those of the Experimental Group in the Post-Test of Arriving at the Correct Solution to the Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Boys	25	5.3600	1.254	24	-6.35	0.01
Experimental Group Boys	25	7.6000	1.291			

Table (21) shows a comparison of the scores of the boys of the control group and those of the experimental group in part five of the post-mathematical word-problem achievement test, which is related to arriving at the correct solution to the word-problems. Comparisons are in favour of the experimental group boys. The mean score of the experimental group boys in the post-mathematical word-problem achievement test is significantly higher than that of the boys of the control group. Experimental group boys achieved a higher mean (**7.6000**) in the post-test than that obtained by those of the control group (**5.3600**). The "t" value (**-6.35**) reveals a highly significant difference between means of scores of the boys of the two groups in the post test. Thus, the fifth sub-hypothesis of hypothesis five is affirmed.

(1.9) Testing Hypothesis Six

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-test of the mathematical word-problem".

Table (22)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Post-Test of Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Girls	25	22.8800	2.635	24	-13.12	0.01
Experimental Group Girls	25	35.1200	3.516			

Table (22) shows a comparison of the scores of the girls of the control group and those of the experimental group in the post administration of the mathematical word-problem achievement test. Comparisons are in favour of the experimental group girls. The mean score of the experimental group girls in the post-mathematical word-problem achievement test is significantly higher than that of the girls of the control group. Experimental group girls achieved a higher mean (**35.1200**) in the post-test than that obtained by those of the control group (**22.8800**).The "t" value (**-13.12**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test. Thus, the sixth hypothesis is affirmed. *For the raw scores of the control group girls and those of the experimental group on the post mathematical word-problem achievement test, see tables (48 & 54), appendix (6), pages (262 & 268).*

(1.9.1) Testing the First Sub-hypothesis of Hypothesis Six

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of reading the content of the mathematical word-problem.**"**

Table (23)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Post-Test of Reading the Content of the Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Girls	25	5.0400	1.060	24	-6.82	0.01
Experimental Group Girls	25	7.1200	.726			

Table (23) shows a comparison of the scores of the girls of the control group and those of the experimental group in part one of the post mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problem. Comparisons are in favour of the experimental group girls. The mean score of the experimental group girls in the post-mathematical word-problem achievement test is significantly higher than that of the girls of the control group. Experimental group girls achieved a higher mean (**7.1200**) in the post-test than that obtained by those of the control group (**5.0400**).The "t" value (**-6.82**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test. Thus, the first sub-hypothesis of hypothesis six is affirmed.

(1.9.2) Testing the Second Sub-hypothesis of Hypothesis Six

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of understanding the content of the mathematical word-problem."

Table (24)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Post-Test of Understanding the Content of the Mathematical Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Girls	25	4.6400	1.254	24	-7.69	0.01
Experimental Group Girls	25	6.8000	1.000			

Table (24) shows a comparison of the scores of the girls of the control group and those of the experimental group in part two of the post mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problem. Comparisons are in favour of the experimental group girls. The mean score of the experimental group girls in the post-mathematical word-problem achievement test is significantly higher than that of the girls of the control group. Experimental group girls achieved a higher mean (**6.8000**) in the post-test than that obtained by those of the control group (**4.6400**).The "t" value (**-7.69**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test. Thus, the second sub-hypothesis of hypothesis six is affirmed.

(1.9.3) Testing the Third Sub-hypothesis of Hypothesis Six

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems.**"**

Table (25)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Post-Test of Converting Digits from Verbal to Symbolic form in the Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Girls	25	4.4800	1.194	24	-8.08	0.01
Experimental Group Girls	25	7.0400	1.306			

Table (25) shows a comparison of the scores of the girls of the control group and those of the experimental group in part three of the post-mathematical word-problem achievement test, which is related to converting the digits from verbal to symbolic form in the word-problems. Comparisons are in favour of the experimental group girls. The mean score of the experimental group girls in the post-mathematical word-problem achievement test is significantly higher than that of the girls of the control group. Experimental group girls achieved a higher mean (**7.0400**) in the post-test than that obtained by those of the control group (**4.4800**).The "t" value (**-8.08**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test. Thus, the third sub-hypothesis of hypothesis six is affirmed.

(1.9.4) Testing the Fourth Sub-hypothesis of Hypothesis Six

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of choice of appropriate mathematical operation in word-problems.**"**

Table (26)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Post-Test of Choosing the Appropriate Mathematical Operation in Solving Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Girls	25	3.6000	1.155	24	-5.85	0.01
Experimental Group Girls	25	5.6800	1.376			

Table (26) shows a comparison of the scores of the girls of the control group and those of the experimental group in part four of the post-mathematical word-problem achievement test, which is related to choosing appropriate mathematical operations in solving word-problems. Comparisons are in favour of the experimental group girls. The mean score of the experimental group girls in the post-mathematical word-problem achievement test is significantly higher than that of the girls of the control group. Experimental group girls achieved a higher mean (**5.6800**) in the post-test than that obtained by those of the control group (**3.6000**).The "t" value (**-5.85**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test. Thus, the fourth sub-hypothesis of hypothesis six is affirmed.

(1.9.5) Testing the Fifth Sub-hypothesis of Hypothesis Six

"There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by the girls of the control group and those of the experimental group in the post-testing of arrival at the correct solution to the word-problems."

Table (27)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Girls of the Control Group and those of the Experimental Group in the Post-Test of Arriving at the Correct Solution to the Word-problems

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Control Group Girls	**25**	**5.1200**	**1.166**	**24**	**-9.85**	**0.01**
Experimental Group Girls	**25**	**8.4800**	**1.447**			

Table (27) shows a comparison of the scores of the girls of the control group and those of the experimental group in part five of the post-mathematical word-problem achievement test, which is related to arriving at the correct solution to the word-problems. Comparisons are in favour of the experimental group girls. The mean score of the experimental group girls in the post-mathematical word-problem achievement test is significantly higher than that of the girls of the control group. Experimental group girls achieved a higher mean (**8.4800**) in the post-test than that obtained by those of the control group (**5.1200**).The "t" value (**-9.85**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test. Thus, the fifth sub-hypothesis of hypothesis six is affirmed.

<u>(1.10) Testing Hypothesis Seven</u>

"There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-test of the mathematical word-problem".

Table (28)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of Girls Versus Boys of the Experimental Group in the Post Mathematical Word-problem Achievement Test

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Student-Girls	25	35.1200	3.516	24	1.99	0.05
Student-Boys	25	33.6800	2.719			

Table (28) shows a comparison of the scores of the girls versus boys of the experimental groups in the post administration of the mathematical word-problem achievement test. Comparisons are in favour of the girls. The mean score of the girls in the post mathematical word-problem achievement test is significantly higher than that of the boys. Girls achieved a higher mean (**35.1200**) in the post-test than that obtained by the boys (**33.6800**). The "t" value (**1.99**) reveals a significant difference between means of scores of the girls versus boys in the post test. *For the raw scores of the girls versus boys on the post mathematical word-problem achievement test, see table (60), appendix (6), page (274).*

<u>(1.10.1) Testing the First Sub-hypothesis of Hypothesis Seven</u>

"There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of reading the content of the mathematical word-problem."

Table (29)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of Girls Versus Boys of the Experimental Group in Part One of the Post Mathematical Word-problem Achievement Test

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Student-Girls	**25**	**7.1200**	**.726**	**24**	**1.44**	**No Significance**
Student-Boys	**25**	**6.8800**	**.600**			

Table (29) shows a comparison of the scores of the girls versus boys of the experimental groups in part one of the post mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problems. Comparisons are in favour of the girls. The mean score of the girls in part one of the post mathematical word-problem achievement test is higher than that of the boys. Girls achieved a higher mean (**7.1200**) in the post-test than that obtained by the boys (**6.8800**). This difference, however, is not statistically significant.

<u>(1.10.2)</u> <u>Testing the Second Sub-hypothesis of Hypothesis Seven</u>

"There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of understanding the content of the mathematical word-problem"

Table (30)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of Girls Versus Boys of the Experimental Group in Part Two of the Post Mathematical Word-problem Achievement Test

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Student-Girls	25	6.8000	1.000	24	-.25	No Significance
Student-Boys	25	6.8800	1.013			

Table (30) shows a comparison of the scores of the girls versus boys of the experimental groups in part two of the post-mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problems. There is no notable difference between the mean scores of the girls and those of the boys in this part of the test. The mean score of the girls is (**6.8000**), and that of the boys is (**6.8800**). Thus there is no significant difference between girls and boys in part two of the post mathematical word-problem achievement test.

(1.10.3) Testing the Third Sub-hypothesis of Hypothesis Seven

"There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of conversion of the digits from verbal to symbolic form in the word-problems".

Table (31)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of Girls Versus Boys of the Experimental Group in Part Three of the Post Mathematical Word-problem Achievement Test

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Student-Girls	25	7.0400	1.306	24	.33	No Significance
Student-Boys	25	6.9600	1.020			

Table (31) shows a comparison of the scores of the girls versus boys of the experimental groups in part three of the post-mathematical word-problem achievement test, which is related to converting digits from verbal to symbolic forms in the mathematical word-problems. There is no notable difference between the mean scores of the girls and those of the boys in this part of the test. The mean score of the girls is (**7.0400**), and that of the boys is (**6.9600**). Thus, there is no significant difference between girls and boys in part three of the post-mathematical word-problem achievement test.

(1.10.4) Testing the Fourth Sub-hypothesis of Hypothesis Seven

"There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of choice of appropriate mathematical operation in word-problems".

Table (32)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of Girls Versus Boys of the Experimental Group in Part Four of the Post Mathematical Word-problem Achievement Test

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Student-Girls	25	5.6800	1.376	24	.53	No Significance
Student-Boys	25	5.5200	1.194			

Table (32) shows a comparison of the scores of the girls versus boys of the experimental groups in part four of the post-mathematical word-problem achievement test, which is related to choosing the appropriate mathematical operation in solving mathematical word-problems. Comparisons are in favour of the girls. The mean score of the girls in part four of the post-mathematical word-problem achievement test is higher than that of the boys. Girls achieved a higher mean (**5.6800**) in the post-test than that obtained by the boys (**5.5200**). This difference, however, is not statistically significant.

(1.10.5) Testing the Fifth Sub-hypothesis of Hypothesis Seven

"There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-testing of arrival at the correct solution to the word-problems**".**

Table (33)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of Girls Versus Boys of the Experimental Group in Part Five of the Post Mathematical Word-problem Achievement Test

Group	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Student-Girls	25	8.4800	1.447	24	2.53	No Significance
Student-Boys	25	7.6000	1.291			

Table (33) shows a comparison of the scores of the girls versus boys of the experimental groups in part five of the post-mathematical word-problem achievement test, which is related to arriving at the correct solution in solving mathematical word-problems. Comparisons are in favour of the girls. The mean score of the girls in part five of the post mathematical word-problem achievement test is higher than that of the boys. Girls achieved a higher mean (**8.4800**) in the post-test than that obtained by the boys (**7.6000**). This difference, however, is not statistically significant.

(2) Pre-post Mathematical Word-problem Attitude Scale Results:

(2.1) Testing Hypothesis Eight

"4th year primary pupils' post assessment mean-scores would be significantly higher than their pre-assessment mean-scores on the mathematical word-problem attitude scale".

Table (34)

The "t" value, Level of Significance, Degree of Freedom, Standard Deviations and Means of Scores of the Subjects of the Experimental Group Students in the Pre-Post Administration of the Mathematical Word-problem Attitude Scale

Administration	N	Mean Score	SD	Degree of Freedom (df.)	t-value	Level of Significance
Pre.	24	86.5833	8.459	23	-52.72	0.01
Post.	24	212.7917	7.558			

Table (34) shows a comparison of the scores of the experimental group subjects in the pre-post administration of the mathematical word-problem attitude scale. Comparisons are in favour of the post administration. The mean score of the experimental group subjects in the post administration of the mathematical word-problem attitude scale is significantly higher than that obtained in the pre administration. Subjects achieved a higher mean (**212.7917**) in the post administration of the scale than that obtained in the pre administration (**86.5833**).The "t" value (**-52.72**) reveals a highly significant difference between means of scores of the experimental group subjects on the pre and the post administration of the scale. Thus the eighth hypothesis is affirmed. *For the raw scores of the experimental group subjects on the pre and the post administration of the mathematical word-problem attitude scale, see tables (66 & 67), appendix (6), pages (280 & 284).*

Summary

This chapter presents the results obtained from the experiment. In testing the study hypotheses, I presented very detailed and well-arranged comparisons of the scores of the control group pupils and those of the experimental group in the pre and the post measurements of performance. The results of these comparisons revealed important improvements in pupils' performance when solving mathematical word-problems as well as in their attitudes towards word-problems in general.

CHAPTER FIVE
DISCUSSION OF THE RESULTS

Introduction

This chapter presents a discussion of the results in two parts: part one covers the results of the pre-post mathematical word-problem achievement test; and part two deals with the results of the mathematical word-problem attitude scale.

(1) Part one. Interpretation and discussion of the results of the pre-post mathematical word-problem achievement test:

(1.1) Results pertaining to the pre-measurement of performance in the mathematical word-problem achievement test.

A comparison of the scores of the subjects of the control groups and those of the experimental groups in the pre mathematical word-problem achievement test reveals no statistically significant difference. Subjects of the control group achieved a mean score of 22.80 out of a total of 50, whereas the mean score of the experimental group subjects was 23.28 out of a total of 50. The “t” value (-.86) reveals no statistically significant difference between mean scores of the subjects of the two groups on the pre-test. This means that there was no apparent difference in the performance level of the two groups when solving mathematical word-problems before attending the suggested programme. Thus, the first hypothesis is affirmed.

When we compare the scores of the subjects of the control and experimental groups in the five parts of the pre mathematical word-problem achievement test, we find no statistically significant differences between means of scores obtained by subjects of the control and experimental groups in any of the five parts of the pre-test. This means that there was no noticeable difference in the pupils’ ability to read and understand mathematical word-problems, convert digits from verbal to symbolic forms in mathematical word-problems, choose the appropriate mathematical operations and to arrive at the correct solutions to mathematical word-problems between the two groups before attending the suggested programme. Thus, the five sub-hypotheses of hypothesis one are affirmed.

A comparison of the scores of the boys of the control group and those of the experimental group in the pre mathematical word-problem achievement test reveals no statistically significant difference. Control group boys obtained a mean score of **22.76** out of a total of 50, whereas the mean score of the experimental group boys was **23.16** out of a total of 50. The "t" value (**-.47**) reveals no statistically significant difference between the mean scores of the boys of the two groups on the pre-test. This means that there was no difference in the performance level of the two groups in solving mathematical word-problems before attending the suggested programme. Similarly, a comparison of the scores of the girls of the control group and those of the experimental group in the pre mathematical word-problem achievement test reveals no statistically significant difference. Control group girls achieved a mean score of **22.84** out of a total of 50, whereas the mean score of the experimental group girls was **23.40** out of a total of 50. The "t" value (**-.76**) reveals no statistically significant difference between the mean scores of the girls of the two groups on the pre-test. This means that the girls of the two groups are equal and that there was no difference in the performance level of the two groups in solving mathematical word-problems before attending the suggested programme.

(1.2) Results pertaining to the post-measurement of performance in the mathematical word-problem achievement test.

A comparison of the scores of the subjects of the control and experimental groups in the post-mathematical word-problem achievement test is in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (34.40) out of a total of 50, in the post test than that obtained by the control group, 22.94 out of a total of 50. The "t" value (-17.31) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. This means that there was a noticeable difference in the performance level of the two groups in solving mathematical word-problems in favour of the experimental group subjects.

These outstandingly high gains shown by subjects of the experimental group are due to the effect of the systematic instruction and training that subjects had in mathematical word-problems.

These findings affirm the second hypothesis and indicate that the experimental group subjects' level of performance surpassed that of the control group in mathematical word-problems. The superiority of the experimental group subjects over those of the control group on the mathematical word-problem achievement test is attributed to the effectiveness of the training programme in mathematical word-problems. This implies that experimental group subjects' level of performance in mathematical word-problems underwent a considerable improvement as a result of attending the suggested programme. Subjects became better able to, read and understand the content of mathematical word-problems, convert the digits from verbal to symbolic forms in mathematical word-problems, choose the appropriate mathematical operations, and consequently arrive at the correct solution. This programme, therefore, had a positive effect on developing 4^{th} year primary pupils' performance in mathematical word-problems in Kuwait.

These results affirm what many researchers have found; there is some evidence that pupils can benefit from even limited exposure to activities designed to raise their general level of performance in mathematical word-problems. Actually, a large body of experimental and quasi-experimental studies (Alawna, 2002; Wells, 2001; Yu Ku, 2001; Jitendra et al., 1998; and Asha & Hoff, 1996; among others) have reported positive effects as a result of interventions in pupils' mathematical word-problem solving. These studies, together with the current one, confirm that through intervention, pupils benefit from direct instruction offered by the classroom teacher who can help them to review their work, recognise their own mistakes, make the required corrections, and develop a perfect understanding of the problem solving procedures. In addition, the results of these studies, together with the present one, indicate that through carefully prepared and conducted interventions, pupils can: improve in using and generating diagrams as a part of the process of solving word-problems; develop the ability to determine when to make metacognitive decisions while solving mathematical word-problems; upgrade those computational skills which are related to solving mathematical word-problems; use a variety of effective mathematical word-problem solving strategies; and consequently, increase the percentage of correct solutions to word-problems.

A comparison of the scores of the subjects of the control and experimental groups in part one of the post mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problem, is in favour of the experimental group. The mean score of the experimental group subjects in part one of the post mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (7 out of a total of 10) in the post test than that obtained by the control group (4.98 out of a total of 10). The "t" value (-9.41) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. This means that there is a noticeable difference in reading the content of the mathematical word-problems in favour of the experimental group subjects. These findings affirm the first sub-hypothesis and indicate that the experimental group subjects' reading of mathematical word-problems underwent a considerable development as a result of the systematic training in reading word-problems that those subjects received in the suggested programme. This programme, therefore, had a positive effect on developing 4th year primary pupils' reading of mathematical word-problems.

These results support the claim made by many researchers (Burns et al., 1998; Roti et al., 2000; and Maikos-Diegnan, 2000; among others), that the language used in mathematics, is different from pupils' everyday language. It is often difficult for pupils to read and understand as it includes a diversity of concepts and words to which they may not have been exposed during their primary-school study. Therefore, it causes some comprehension difficulties in terms of solving the word-problem and, consequently, affects the outcome of a child's problem solving efforts.

Through the suggested mathematical word-problem programme, experimental group pupils were given direct and explicit teaching of the mathematical vocabulary items and concepts used in word-problems. These items included words and expressions used in the different mathematical operations; addition, subtraction, multiplication and division. In addition, experimental group pupils had the opportunity to practice reading and solving a variety of word-problems under the direct and close supervision of the teacher. As a result, experimental group pupils had little difficulty in reading word-problems in the post-mathematical word-problem achievement test, as compared to the control group pupils.

A comparison of the scores of the subjects of the control and experimental groups in part two of the post-mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problems, is in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (6.84 out of a total of 10) in the post test than that obtained by the control group (4.56 out of a total of 10). The "t" value (-9.97) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. This means that there is a noticeable difference between subjects of the two groups; experimental group subjects outperformed control group subjects in understanding the content of the mathematical word-problems. These findings affirm the second sub-hypothesis and indicate that the experimental group subjects' understanding of the content of the mathematical word-problems underwent a considerable improvement. This improvement is attributed to the effectiveness of the suggested training programme. This implies that experimental group subjects became better able to understand the content of given mathematical word-problems and this programme, therefore, had a positive effect on developing 4th year primary pupils' understanding of mathematical word-problems.

These results are compatible with those of Hanan (2000), Essa (2002), Ana & Jimenez (2006), Villa (2008), and Vilenius, et al. (2008), among others, who concluded that one of the most challenging difficulties associated with mathematics teaching and learning in the primary educational stage is understanding the meanings when attempting to solve a mathematical word-problem. This lack of understanding is often a direct result of the pupil's inability to read the problem effectively (Blessman & Myszczak, 2001, as cited in Kittell, 2007). Bearing in mind that understanding the mathematical word-problem is the most important step on the way to solving that problem, direct and systematic training and instruction was offered in the suggested programme. Through this training, experimental group pupils had the opportunity to read and understand a variety of word-problems. They were trained in how to better understand a word-problem by being asked questions that test understanding of a given problem. They were also trained in how to recognise the available data included in a given word-problem. As a result, experimental group pupils, had less difficulty, compared to control group pupils, in understanding the content of word-problems in the post mathematical word-problem achievement test.

A comparison of the scores of the subjects of the control and experimental groups in part three of the post-mathematical word-problem achievement test, which is related to converting digits from verbal to symbolic forms in the mathematical word-problems, is in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (7 out of a total of 10) in the post test than that obtained by the control group (4.52 out of a total of 10). The "t" value (-11.00) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. This means that there is a noticeable difference between subjects of the two groups; experimental group subjects outperformed control group subjects in converting digits from verbal to symbolic forms in the mathematical word-problems. These findings affirm the third sub-hypothesis and indicate that the experimental group subjects' ability to convert digits from verbal to symbolic forms in mathematical word-problems underwent a considerable improvement. This improvement is attributed to the effectiveness of the suggested training programme. This implies that experimental group subjects became better able to convert digits from verbal to symbolic forms in the given mathematical word-problems. This programme, therefore, had a positive effect on developing 4^{th} year primary pupils' ability to convert digits from verbal to symbolic forms in mathematical word-problems.

These findings are consistent with those of many researchers who concluded that most primary school pupils lack the ability to decode symbolic language into mathematical language. They experience some difficulty in figuring out the relationship between the words and the symbols included in mathematical word-problems. They often rely on superficial cues that can lead to incorrect solutions (Englert, et al., 1987; Parmar, 1992; Parmar, et al., 1996; Rivera, 1997, as cited in Hartman, 2007; Hart, 1996, as cited in Yu Ku, 2001; Roti et al., 2000; Essa, 2002; Villa, 2008 and Blessman & Myszczak, 2001, as cited in Kittell, 2007).

Through the suggested mathematical word-problem programme, experimental group subjects were trained in how to decode symbolic language into mathematical language. They had the opportunity to find out how to convert numerical language concepts into mathematical symbols in a variety of word-problems. As a result, experimental group subject performances surpassed those of the control group, who did not have such an opportunity, in converting digits from verbal to symbolic forms in the post-mathematical word-problem achievement test.

A comparison of the scores of the subjects of the control and experimental groups in part four of the post-mathematical word-problem achievement test, which is related to choosing the appropriate mathematical operation in solving the mathematical word-problems, is in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (5.60 out of a total of 8) in the post test than that obtained by the control group (3.64 out of a total of 8). The "t" value (-7.77) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. This means that there is a remarkable difference between subjects of the experimental group and those of the control group. Experimental group subjects surpassed control group subjects in choosing the appropriate operations when solving mathematical word-problems. These findings affirm the fourth sub-hypothesis and indicate that the experimental group subjects' skill of choosing the appropriate mathematical operations in solving mathematical word-problems underwent a significant improvement. This improvement is attributed to the effectiveness of the suggested training programme. This implies that experimental group subjects became better able to choose the appropriate mathematical operations in solving given mathematical word-problems. This programme, therefore, had a positive effect on developing 4^{th} year primary pupils' skill in choosing the appropriate mathematical operations when solving given mathematical word-problems.

These results are similar to those of many researchers (Suppes et al., 1969; Hart, 1996, as cited in Yu Ku, 2001; and Villa, 2008), who concluded that the correct choice of the type and number of mathematical operations needed influence the level of difficulty of the process when solving a given word-problem.

By attending the suggested mathematical word-problem programme, experimental group subjects were trained in how to convert word-problems into mathematical operations. They also had the opportunity to develop their skills in determining the number and type of the needed mathematical operations in a variety of word-problems. Experimental group pupils could make use of their knowledge of the many keywords that they studied in the suggested programme, such as increase, multiply, total, together, the difference, subtract, add, addition, divide, and division. These words guide the pupil to the appropriate mathematical operation while solving a given problem. They used this knowledge in determining the correct operation and consequently they were successful and experienced little difficulty as compared to their peers in the control group who did not have such an opportunity.

As a result, experimental group subjects outperformed those of the control group in choosing the appropriate mathematical operations when solving given mathematical word-problems on the post-mathematical word-problem achievement test.

A comparison of the scores of the subjects of the control and experimental groups in part five of the post mathematical word-problem achievement test, which is related to arriving at the correct solution to the mathematical word-problems is in favour of the experimental group. The mean score of the experimental group subjects in the post-mathematical word-problem achievement test is significantly higher than that of the control group. Experimental group subjects achieved a higher mean (5.24 out of a total of 12) in the post test than that obtained by the control group (8.04 out of a total of 12). The "t" value (-10.96) reveals a highly significant difference between means of scores of the control and experimental group subjects in the post test. This means that there is an outstanding difference between subjects of the experimental group and those of the control group. Experimental group subjects exceeded control group subjects' performance in arriving at the correct solution to the mathematical word-problems. These findings affirm the fifth sub-hypothesis and indicate that the experimental group subjects' ability of arrive at the correct solution to the mathematical word-problems underwent a significant development. This development is attributed to the usefulness of the suggested training programme. This implies that experimental group subjects became better able to arrive at the correct solutions to the given mathematical word-problems. This programme, therefore, had a positive effect on developing 4th year primary pupils' ability to arrive at the correct solution to the given mathematical word-problems.

As a matter of fact, arriving at the correct solution to a given word-problem is influenced by the pupil's ability to read and understand the content of the problem, his/her skill in converting mathematical language concepts into mathematical symbols, and his/her ability to best choose the appropriate mathematical operation needed. Fortunately, through the suggested programme, experimental group subjects had the opportunity, which was not available to control group subjects, to develop their abilities in reading and understanding the content of mathematical word-problems, converting digits from verbal to symbolic forms, choosing the appropriate mathematical operations needed, and consequently arriving at the correct solutions. Consequently, experimental group subjects outperformed those of the control group in arriving at the correct solutions to given word-problems on the post mathematical word-problem achievement test.

If we compare the scores of the boys of the control group and those of the experimental group in the post-mathematical word-problem achievement test, we find that comparisons are in favour of the experimental group boys. Experimental group boys achieved a higher mean (**33.68** out of a total of 50) in the post-test than that obtained by those of the control group (**23.00** out of a total of 50). The "t" value (**-11.46**) reveals a highly significant difference between means of scores of the boys of the two groups on the post-test . Likewise, if we compare the scores of the girls of the control group and those of the experimental group in the post-mathematical word-problem achievement test, we find that comparisons are in favour of the experimental group girls. Experimental group girls achieved a higher mean (**35.12** out of a total of 50) in the post-test than that obtained by those of the control group (**22.88** out of a total of 50). The "t" value (**-13.12**) reveals a highly significant difference between means of scores of the girls of the two groups in the post test.

The superiority of the experimental group girls over those of the control group in the post-mathematical word-problem achievement test is, as mentioned above, attributed to the effectiveness of the suggested training programme in mathematical word-problems.

This implies that experimental group girls' level of performance in solving mathematical word-problems underwent a significant improvement because they attended the suggested programme. Girls of the experimental group surpassed those of the control group in their performance in solving word problems.

(1.3) Results pertaining to comparison of the performance of girls versus boys in the post mathematical word-problem achievement test.

A comparison of the scores of the girls versus boys of the experimental groups in the post administration of the mathematical word-problem achievement test is in favour of the girls. The mean score of the girls in the post mathematical word-problem achievement test is significantly higher than that of the boys. Girls achieved a higher mean (35.12 out of a total of 50), in the post test than that obtained by the boys (33.68 out of a total of 50). The "t" value (1.99) reveals a significant difference between means of scores of the girls versus boys in the post test. This means that there is an obvious difference in the performance level of the girls versus boys in solving mathematical word-problems. In mathematical word-problems the girls outperformed the boys.

During my repeated visits to the chosen schools and from observations inside the selected classrooms and discussions with the teachers who undertook to teach my suggested programme, it was observed that girls were more careful than boys; they used to ask the teacher from time to time for clarification, and they were more relaxed than boys. In addition, they maintained their participation and involvement in class work throughout all of the sessions of the programme. Girls were more likely to ask and inquire about many important things related to mathematics learning. They never felt shy or reluctant to answer a question or solve a problem given by the teacher, even if they might make mistakes. They were more competitive and more collaborative than boys. They were fully confident that to err is to learn. On the other hand, it was observed that boys were less careful than girls; they seldom asked the teacher to clarify or to repeat an explanation. They were less keen to participate and engage in classroom work, unless the teacher invited them. It was also observed that boys were more shy and afraid of making mistakes than girls.

I have generally observed as a Kuwaiti citizen that Kuwaiti girls are more interested in education than boys are. Girls are more careful than boys when studying at home and more likely to finish the homework assigned to them by their teachers. They usually spend longer hours at home than boys. On the other hand, boys are less careful in education than girls. They are also less likely to finish their homework and to stay at home for lengthy periods. They are usually more interested than girls in going out, playing and chatting with their friends. Consequently, it is not surprising that girls outperform boys on the post mathematical word-problem achievement test.

A comparison of the scores of the girls versus boys of the experimental groups in part one of the post mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problems is in favour of the girls. The mean score of the girls in part one of the post mathematical word-problem achievement test is higher than that of the boys. Girls achieved a higher mean (7.12 out of a total of 10) in the post test than that obtained by the boys (6.88 out of a total of 10). This difference, however, is not statistically significant.

This finding indicates that girls' ability to read mathematical word-problems is better than that of the boys on the post-mathematical word-problem achievement test. This might be due to their carefulness and sincere desire to learn when studying the suggested programme. It seems that girls benefited, more than boys did from the sessions devoted to teaching and learning the content of mathematical word-problems. They mastered recognizing and reading the mathematical words and expressions presented in the suggested programme, which are commonly used in the content of mathematical word-problems. In addition, girls' participation and involvement in the classroom during teaching of the suggested programme gave them the opportunity to become better trained in reading than boys, and this, to some extent, gave them the courage to read and recognise words in the test better than boys.

Comparing the scores of the girls versus boys of the experimental groups in part two of the post-mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problems, no notable difference is shown between the mean scores of the girls and those of the boys in this part of the test. The mean score of the girls is 6.80 out of a total of 10, and that of the boys is 6.88 out of a total of 10. Hence, there is no significant difference between girls and boys in part two of the post-mathematical word-problem achievement test. This means that there is no clear difference between girls and boys in understanding the content of the mathematical word-problems.

In comparing the scores of the girls of the experimental groups with those of the boys in part three of the post-mathematical word-problem achievement test, which is related to converting digits from verbal to symbolic forms in mathematical word-problems, there is no significant difference between the mean scores of the girls and those of the boys in this part of the test. The mean score of the girls is 7.04 out of a total of 10, and that of the boys is 6.96 out of a total of 10. Thus, there is no significant difference between girls and boys in part three of the post-mathematical word-problem achievement test. This means that there is no obvious difference between girls and boys in converting digits from verbal to symbolic forms in mathematical word-problems.

A comparison of the scores of girls versus boys of the experimental groups in part four of the post-mathematical word-problem achievement test, which is related to choosing the appropriate mathematical operation in solving mathematical word-problems, is in favour of the girls. The mean score of the girls in part four of the post-mathematical word-problem achievement test is higher than that of the boys. Girls achieved a higher mean (5.68 out of a total of 8) in the post test than that obtained by the boys (5.52 out of a total of 8). This difference, however, is not statistically significant.

A comparison of the scores of girls versus boys of the experimental groups in part five of the post mathematical word-problem achievement test, which is related to arriving at the correct solution when solving mathematical word-problems is in favour of the girls. The mean score of the girls in part five of the post mathematical word-problem achievement test is higher than that of the boys. Girls achieved a higher mean (8.48 out of 12) in the post-test than that obtained by the boys (7.60 out of 12). This difference, however, is not statistically significant.

These findings indicate that girls were more skilled than boys in choosing the appropriate mathematical operations and in arriving at the correct solution to mathematical word-problems. This might also be due to their attentiveness and honest desire to benefit from the suggested programme. Girls' superior practice and participation during the teaching of the suggested programme led to better performance in the post-mathematical word-problem achievement test.

(2) Part two. Interpretation and discussion of the results of the pre-post mathematical word-problem attitude scale:

A comparison of the scores of the experimental group subjects in the pre-post administration of the mathematical word-problem attitude scale is in favour of the post administration. The mean score of the experimental group subjects in the post administration of the mathematical word-problem attitude scale is significantly higher than that obtained in the pre administration. Subjects achieved a higher mean (212.79 out of a total of 250) in the post administration of the scale than that obtained in the pre administration (86.58 out of a total of 250). The "t" value (-52.72) reveals a highly significant difference between means of scores of the experimental group subjects on the pre and the post administration of the scale. This means that there is a remarkable difference between the mean scores of the experimental group subjects in the pre and the post administration of the mathematical word-problem attitude scale. Experimental group subjects' scores in the post administration surpassed their scores in the pre administration of the scale. These findings affirm the third hypothesis and indicate that the experimental group subjects' attitudes towards mathematical word-problems underwent an outstanding change because of having attended the suggested programme. Experimental group subjects' attitudes towards mathematical word-problems became more positive than before.

These results are consistent with the commonly held belief among researchers and experts in the field of teaching and learning that pupils benefit from exposure to learning opportunities and activities especially designed to enhance their level of performance in a specific subject, and that it often leads to a positive change in their attitudes towards that subject. More specifically, in the field of mathematics, the post intervention data in the study of Benko (1999) revealed an increase in strategy use, a positive change in pupils' attitudes towards mathematical word-problems, and an increase in time spent on the solution of each word-problem. In the study by Yu Ku (2001), a mathematical word-problem programme based on personalized instruction improved Taiwanese pupils' achievement level and led to significantly more positive attitudes towards mathematics instruction.

These studies, together with the current one, confirm that through intervention and offering learning opportunities and activities carefully prepared and designed to improve pupils' performance in a certain subject, pupils have the opportunity to change their beliefs and attitudes towards that subject. Better understanding and performance on the part of the pupils leads them to correct their way of thinking and misconceptions towards a given subject.

This is the case in the current study; after attending the suggested programme, experimental group subjects no longer feel scared or under a terrible strain in a mathematical word-problem class. They no longer have a feeling of restlessness, irritability, dislike or impatience towards mathematical word-problems. On the contrary, mathematical word-problems became not only very interesting and stimulating for them, but also fascinating and fun.

After attending the suggested programme, experimental group subjects no longer approach mathematical word-problems with a feeling of hesitation; they feel at ease with them. They no longer feel afraid of experiencing difficulties in reading and understanding the content of word-problems. In addition, they no longer feel afraid of having trouble converting digits from verbal to symbolic forms or deciding the appropriate mathematical operations needed to solve these problems. Moreover, experimental group subjects no longer feel uneasy about their solutions to mathematical word-problems. On the contrary, they feel confident in their solutions to given word-problems. This programme, therefore, had a positive effect on 4^{th} year primary pupils' attitudes towards mathematical word-problems.

Summary

It is clear from the above-mentioned discussions that the suggested mathematical word-problem programme had a positive effect on the performance of the 4^{th} year primary school pupils who were involved. It is also clear that the suggested programme improved pupils' performance in solving word-problems in the five main areas of difficulty identified in this study; it enhanced their ability to read and understand the content of word-problems, convert mathematical language concepts into mathematical symbols, choose the appropriate mathematical operation needed and to arrive at the correct solution to these problems.

CHAPTER SIX

SUMMARY OF THE STUDY

Summary

The chief objective of the current study was to measure the effect of using a suggested mathematical word-problem training programme on Primary 4 pupils' performance in that area. The study tried to answer the following questions:

(1) What are the difficulties experienced by 4th year primary pupils in solving mathematical word-problems in Kuwait?

(2) What is the effect of such a programme on 4th year primary school pupils' performance in mathematical word-problems?

This last question was further divided into five sub-questions;

(2.1) What is the effect of the suggested programme on 4th year primary school pupils' performance when reading the content of word-problems?

(2.2) What is the effect of the suggested programme on 4th year primary school pupils' performance in terms of understanding the content of word-problems?

(2.3) What is the effect of the suggested programme on 4th year primary school pupils' performance when converting the digits from verbal to symbolic forms in word-problems?

(2.4) What is the effect of the suggested programme on 4th year primary school pupils' performance when choosing the appropriate mathematical operations in solving word-problems?

(2.5) What is the effect of the suggested programme on 4th year primary school pupils' performance when arriving at the correct solution to word-problems?

(3) What is the effect of the suggested programme on 4th year primary

school pupils' attitudes towards mathematical word-problems?

The study was conducted on a sample of 4^{th} year primary pupils in Kuwaiti schools. The study sample comprised 100 4^{th} year primary school pupils from two different schools; one for girls and the other for boys; fifty (50) from Hisham Ibn Omayaa primary school for boys and the other fifty (50) from Lobaba Bint Al-haareth primary school for girls. They were assigned to four groups; two groups in each school, one of which was experimental and the other control.

The study was based on the following main hypotheses:

(1) There is no statistically significant difference between the means of scores obtained by subjects of the control group and those of the experimental group in the pre-test of the mathematical word-problem.

(2) There is a statistically significant difference (favouring the experimental group) between the means of scores obtained by subjects of the control group and those of the experimental group in the post-test of the mathematical word-problem.

(3) There is a statistically significant difference (favouring the girls of the experimental group) between the means of scores obtained by the girls of the experimental group and those of the boys in the post-test of the mathematical word-problem.

(4) Fourth year primary pupils' post assessment mean-scores would be significantly higher than their pre-assessment mean-scores on the mathematical word-problem attitude scale.

The study has a pre-post control group design. A treatment and a no-treatment group were exposed to pre-post methods of collecting data (a mathematical word-problem achievement test and a mathematical word-problem attitude scale). The treatment groups were given direct and explicit training on how to solve mathematical word-problems, while the pupils of the no-treatment group received no such training; they were taught the same material they study at school.

The instruments, prepared and used by me in this study with respect to 4th year primary pupils included: a needs assessment questionnaire - prepared by me to assess difficulties in solving mathematical word-problems from the primary school mathematics teachers' points of view, and therefore, to diagnose their needs for mathematical word-problem instruction; a mathematical word-problem programme - for developing performance in word-problems; a pre-post-mathematical word-problem achievement test - aimed at measuring performance in mathematical word-problems; and a mathematical word-problem attitude scale - to identify attitudes towards mathematical word-problems before and after studying the suggested programme.

Conclusions

A "t" test was used to compare the means of scores of the control group pupils and those of the experimental group in the post administration of the mathematical word-problem achievement test. Comparisons were in favour of the experimental group pupils. The mean score of the experimental group pupils in the post-mathematical word-problem achievement test was significantly higher than that of the control group pupils. Experimental group pupils achieved a higher mean (**34.4000**) in the post-test than that obtained by those of the control group (**22.9400**). The "t" value (**-17.31**) revealed a highly significant difference between the mean scores of the two groups in the post-test.

A comparison of the scores of the pupils of the two groups in part one of the post-mathematical word-problem achievement test, which is related to reading the content of the mathematical word-problem was in favour of the experimental group. The mean score of the experimental group subjects in the post-test was significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**7.0000**) in the post-test than that obtained by the control group (**4.9800**). The "t" value (**-9.41**) revealed a highly significant difference between the mean scores of the two groups in the post-test.

A comparison of the scores of the pupils of the two groups in part two of the post-mathematical word-problem achievement test, which is related to understanding the content of the mathematical word-problems, was in favour of the experimental group pupils. The mean score of the experimental group subjects in the post-test was significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**6.8400**) in the post-test than that obtained by the control group (**4.5600**). The "t" value (**-9.97**) revealed a highly significant difference between means of scores of the control and experimental group subjects in the post-test.

A comparison of the scores of the pupils of the two groups in part three of the post-mathematical word-problem achievement test, which is related to converting digits from verbal to symbolic forms in the mathematical word-problems, was in favour of the experimental group pupils. The mean score of the experimental group subjects in the post-test was significantly higher than that of the control group. Experimental group pupils achieved a higher mean (**7.0000**) in the post-test than that obtained by those of the control group (**4.5200**). The "t" value **(-11.00**) revealed a highly significant difference between means of scores of the two groups in the post-test.

A comparison of the scores of the pupils of the two groups in part four of the post-mathematical word-problem achievement test, which is related to choosing the appropriate mathematical operation in solving the mathematical word-problems, was in favour of the experimental group pupils. The mean score of the experimental group in the post-test was significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**5.6000**) in the post-test than that obtained by the control group (**3.6400**). The "t" value **(-**

7.77) reveals a highly significant difference between means of scores of the two groups in the post-test.

A comparison of the scores of the pupils of the two groups in part five of the post-mathematical word-problem achievement test, which is related to arriving at the correct solution to the mathematical word-problems, was in favour of the experimental group pupils. The mean score of the experimental group in the post-test was significantly higher than that of the control group. Experimental group subjects achieved a higher mean (**8.0400**) in the post-test than that obtained by the control group (**5.2400**). The "t" value **(-10.96**) reveals a highly significant difference between means of scores of the two groups in the post-test.

These results indicated that experimental group pupils' performance on mathematical word-problems underwent a significant improvement as a result of attending the suggested programme. Fourth year primary school pupils became better able to read and understand the content of mathematical word-problems, convert the digits from verbal to symbolic forms, choose the suitable mathematical operations for solving given word-problems and consequently arrive at the accurate solution to mathematical word-problems. The suggested programme, therefore, had a positive effect on developing 4^{th} year Kuwaiti primary school pupils' performance in mathematical word-problems.

These results are in line with what many researchers in the field have found. Exposing primary school pupils to activities specifically designed to raise their level of performance in solving mathematical word-problems can have a profound effect on their mathematical word-problem solving abilities (Samelson, 2009; Jitendra et al., 2007; Delinda, 2007; Teong, 2003; among others).

A comparison of the scores of the girls versus boys of the experimental groups in the post administration of the mathematical word-problem achievement test was in favour of the girls. Girls achieved a higher mean (**35.1200**) in the post-test than that obtained by the boys (**33.6800**). The "t" value

(**1.99**) reveals a significant difference between means of scores of the girls and those of the boys in the post-test. This means that there is an obvious difference in the performance level of girls versus boys in solving mathematical word-problems. Girls outperformed boys in mathematical word-problems. This superiority of the girls over the boys in the post-mathematical word-problem achievement test is due to the girls' greater ability to read word-problems, choose the appropriate mathematical operations and to arrive at the correct solution to these problems.

As indicated by the teachers who taught the suggested programme and my personal classroom observations during repeated visits to the sample schools, girls are more likely to ask and inquire about many important things related to mathematics learning. They seldom feel shy or reluctant to answer a question or solve a problem given by the teacher, even if they might make mistakes. They are more competitive and more collaborative than boys. In Kuwait, they even study at home for longer than boys. This enthusiasm to study and to participate was also reflected in their attitudes towards the suggested programme.

A "t" test was also used to compare the scores of the experimental group subjects in the pre-post administration of the mathematical word-problem attitude scale. Comparisons were in favour of the post administration. The mean score of the experimental group subjects in the post administration of the mathematical word-problem attitude scale was significantly higher than that obtained in the pre administration. Subjects obtained a higher mean (**212.7917**) in the post administration of the scale than that obtained in the pre administration (**86.5833**). The "t" value (**-52.72**) reveals a highly significant difference between means of scores of the experimental group subjects in the pre and the post administration of the scale.

These findings indicated that the experimental group subjects' attitudes towards mathematical word-problems underwent an exceptional change because they had attended the suggested programme. Experimental group subjects' attitudes towards mathematical word-problems became more positive than before. The suggested programme, therefore, had a positive effect on 4th year primary pupils' attitudes towards mathematical word-problems.

It is worth mentioning that I faced some difficulties in conducting this study. The first was related to governmental bureaucracy in Kuwait; in order to implement my suggested programme on a sample of school pupils, I had to obtain more than four letters of acceptance, starting with the ministry of education itself and ending with the school administration. This of course was **a great waste of time** and involved a great deal of effort on my part to convince them of the usefulness of my suggested programme for Kuwaiti primary school pupils.

Finding mathematics teachers who were prepared to teach the suggested programme was also a problem; teachers were reluctant, at first, to teach this programme and they doubted its validity and its usefulness as compared to the existing curriculum. In addition, mathematics supervisors, who came from the ministry of education to check and supervise the teaching and learning of mathematics in the primary schools, were at first against teaching my suggested programme. They expressed fears about wasting the pupils' time in a programme that might not be of benefit to them. After I had explained the objectives of the programme and convinced both the teachers and their supervisors about its validity, they were encouraged to teach it to their pupils.

It was apparent that pupils were at first afraid and reluctant to take the pre-test because they thought that it would affect their final scores. Their teachers convinced them that the test bore no relation to their final scores and that its purpose was to evaluate the effectiveness of the suggested programme. During teaching of the programme, teachers who taught it noted that both pupils and parents were worried about it. Parents were reluctant to let their children participate for fear that it might waste their time and would be of little benefit.

This was evident in the repeated visits made by parents during this time and in their frequent questions about its usefulness to their offspring. Gradually, their fears disappeared and at the end of the programme they were completely satisfied with the results.

As always there is the possibility that bias may interfere with the conduct of a study when the teacher is the researcher so in order to eliminate any bias I did not participate in teaching the suggested programme.

Based on my classroom observations and those of the teachers who taught the programme, care should be taken with future implementations, as the second area of difficulty that deals with understanding mathematical word-problems should have been given greater emphasis. Two lessons were devoted to this area despite its critical importance to solving word-problems. Three lessons should be allotted to teaching this area instead of two. On the other hand, the third area that deals with converting digits from verbal into symbolic forms was taught in two lessons, although one would have been quite sufficient as pupils experienced little difficulty in this area.

An important limitation of this study is that the difference between the attitudes of the boys and those of the girls of the experimental group towards mathematical word-problems was not measured. If that difference was measured it might explain the enthusiasm on the part of the girls to study and to participate during teaching of the suggested programme. In addition, care should be taken not to generalize the results of the relatively small number of participants in this study to the larger population, especially since they were not randomly selected.

The effectiveness of the suggested programme was examined for a relatively short period of time. Some lessons might have required more time to be internalized by the students. Results may differ if the same study was done over an extensive period of time. A potential limitation may have been that some pupils missed one or more lessons of the suggested programme and therefore did not receive the same amount of exposure and did not complete the same number of sessions; yet they attended the pre-post-test. This should be kept in mind when considering the results of this study.

Another possible limitation is that pupils were not given a blank page to use **for their workings** especially for the questions in part five of the pre-post-mathematical word-problem achievement test and they were not instructed where to make their drafts. This should be highlighted when considering the results of the study.

Implications

There are several implications for practice based on the results of this study. Direct teaching of mathematics vocabulary should be part of the curriculum of primary school pupils, and should be taught systematically. In addition, direct teaching of reading mathematical word-problems and converting mathematical language concepts into mathematical symbols should also be part of the mathematics curriculum of primary school pupils. Moreover, direct teaching of how to choose the appropriate mathematical operation/s needed for solving word-problems should be part of the mathematics curriculum of primary school pupils from the beginning of their learning.

Given that this programme did affect primary school pupils' performance in solving word-problems, the materials and the procedures used will be a useful guide for teachers when designing word-problem instructions. In addition, curriculum developers should endeavour to include word-problems that use ordinary situations experienced by the pupils in their daily lives within primary school mathematics textbooks and aim to use vocabulary known and used by the average primary school pupil.

Pre-service teachers of mathematics should be given training in direct teaching of word-problems whilst at university. In addition, a specific component dealing with the explicit teaching of mathematical vocabulary should also be incorporated. At the same time, in-service teachers of mathematics should be given training on effective teaching strategies for mathematical word-problems.

Further research

A great deal of further research is needed to identify best practices in mathematical word-problem solving instruction. Further descriptive studies are also required to identify new ways and techniques for teaching mathematical vocabulary to primary school pupils. More studies are also needed to identify new approaches to teaching the reading of word-problems to primary school pupils. New means of teaching how to choose the appropriate mathematical operation/s for solving word-problems should also be further researched.

It is also worth investigating how Kuwaiti primary school pupils approach solving word-problems and what are the learning strategies used by those pupils in solving these problems. Further descriptive studies are also needed to investigate current classroom-based methods and techniques of teaching word-problems and how far these enhance or hinder pupils' performance.

In future research a replication of this study with a greater number of pupils from primary schools in Kuwait would be useful. Similarly, future research could replicate this study with different samples from different regions in the state of Kuwait.

Based on the results, it can be stated that the present study's unique contribution to knowledge is that Kuwaiti primary school pupils' performance in mathematical word-problems can be developed through systematic exposure to activities specifically designed for this purpose. In addition, the development of their performance leads to positive attitudes towards word-problems.

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Appendix (1)

Jury Members who judged the Tools of the Study

- **Dr. Abdul-Raheem Al-Kandari**
  Prof. of Curriculum and Instruction, Faculty of Education, Kuwait University.

- **Dr. Mohammed Taaleb**
  Assistant Professor of Curriculum and Instruction, Faculty of Education, Kuwait University.

- **Dr. Motlaq Al-Enezi**
  Associate Prof. of School Management, Faculty of Education, Kuwait University.

- **Dr. Mad Allah**
  Assoistant Prof. of Curriculum and Instruction, Faculty of Education, Kuwait University.

- **Mr. Osama Abo-Sennah**
  Mathematics Supervisor, Ministry of Education, Kuwait.

Appendix (2)

Pilot Study Mathematical Word-Problem Diagnostic Test

Pupil's Name:……………………………………………………

☒ Read the following word-problems and solve them. You may use the last four unlined pages in this test booklet as a draft for your solutions to the given problems.

(1) Your mathematics teacher asked you to multiply five hundred and thirty five by two hundred and fifteen. What is the correct solution to this problem?

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(2) Khalid bought a new car for three thousand and forty Kuwaiti Dinars and his Cousin Ahmad bought another one for four thousand two hundred Kuwaiti Dinars. How much did they pay for both cars?

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(3) Japer has seven hundred and seventy Kuwaiti Dinars while Falaah has eight hundred and forty five. What is the difference between what Japer and Falaah have?

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(4) Fatma is one hundred and fifty four centimetres, while Noora is one hundred and thirty nine. Who is taller, Fatma or Noora?

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(5) An aged man has four hundred and twenty acres of land. Being afraid of death, he wanted to divide these acres equally by his six children. How many acres will each one of the six children take?

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(6) Ranya has ninety nine Saudi Riyals while her brother Mostafa has three hundred and thirty four. Because she wanted to buy a new scooter, Ranya borrowed her brother's money and he agreed to lend it to her as a loan. What is the total sum of money Ranya will have after adding her brother's money to her own?

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End of Test

APPENDIX (3)

A QUESTIONNAIRE FOR IDENTIFYING 4TH YEAR PRIMARY PUPILS' DIFFICULTIES IN SOLVING MATHEMATICAL WORD-PROBLEMS

Brunel University

School of sport and Education

Dear Jury Member,

The researcher is conducting a study for a Ph.D. Degree. This research is aimed at measuring the effect of a suggested programme for developing 4th year primary pupils' performance in mathematical word-problems in Kuwait.

Attached is a needs assessment questionnaire which is intended to identify 4th year primary pupils' difficulties in solving mathematical word-problems from the primary school mathematics teachers' point of view, and therefore, to help diagnose their needs for mathematical word-problem training.

You are kindly requested to judge the suitability and validity of this questionnaire in terms of:

1 - Stating the items.

2 - Fitness of the items for the group of study.

Your valuable comments on this questionnaire will help answer the following question:

What are the difficulties experienced by 4th year primary students in solving mathematical word-problems?

Your help and cooperation are greatly appreciated

Sincerely

Meshal Al mansouri

Brunel University

School of Sport and Education

Dear Teacher,

The researcher is conducting a study for a Ph.D. Degree. This research is aimed at measuring the effect of a suggested programme for developing 4th year primary pupils' performance in mathematical word-problems in Kuwait.

Attached is a needs assessment questionnaire for identifying 4th year primary pupils difficulties in solving mathematical word-problems from your point of view, and therefore, diagnose their needs for mathematical word-problem instruction.

Your scores on this questionnaire will help answer the following question:

What are the difficulties experienced by 4th year primary students in solving mathematical word-problems?

Your cooperation is greatly appreciated.

Sincerely

Meshal Al mansouri

Brunel University

School of Sport and Education

Needs Assessment Questionnaire for Identifying 4th Year Primary Pupils' Difficulties in Solving Mathematical Word-problems

Directions

1. The questionnaire comprises (5) statements and an open question.

2. You are kindly asked to respond to all the statements and answer the open question.

3. There is no right or wrong answer to these statements.

4. Time allowed is about (20-30) minutes.

5. Please read each statement and mark the one response **a, b, c, d** or **e** that best describes your actual attitude concerning what you actually observe when you are teaching 4th year primary pupils.

- **(a)** Strongly disagree
- **(b)** Moderately disagree
- **(c)** Somewhat agree
- **(d)** Moderately agree
- **(e)** Strongly agree

6. Answer in terms of how well the statement describes your attitude. Do not answer in terms of how you think your attitude should be, or what other people's attitudes are.

7. If you have any questions, let the researcher know immediately.

Your cooperation is greatly appreciated.

Yours

Meshal Al mansouri

Needs Assessment Questionnaire for Identifying 4th Year Primary Pupils' Difficulties in Solving Mathematical Word-problems

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Teacher's Name:………………………………………………………

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While teaching mathematics to 4th year primary school pupils in Kuwait, I notice that they experience difficulties in solving word-problems in the following areas;

No.	Areas of Difficulty	(A) Strongly disagree	(B) Moderately disagree	(C) Somewhat agree	(D) Moderately agree	(E) Strongly agree
1.	Reading the content of mathematical word-problems.					
2.	Understanding the content of mathematical word-problems.					
3.	Converting the digits from verbal to symbolic forms in mathematical word-problems.					

4.	Choosing the appropriate operations in solving mathematical word-problems.					
5.	Arriving at the correct solution to mathematical word-problems.					

Please mention if there any other difficulties.

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<u>End of the Questionnaire</u>

Appendix (4)

Pre-post Mathematical Word-problem Achievement Test

Brunel University
School of Sport and Education

Dear Jury Member,

The researcher is conducting a study for a Ph.D. Degree. This research is aimed at measuring the effect of a suggested programme for developing 4th year primary pupils' performance in mathematical word-problems in Kuwait.

To measure the effect of the suggested programme, the researcher is preparing the present pre-post mathematical word-problem achievement test. This test is intended to measure 4th year primary school pupils' achievement in solving mathematical word-problems.

The test is divided into five parts comprising thirty (30) items; the entire test parts are designed in multiple choice format except for part one which is designed in a matching format question. Each item of the multiple choice formatted items includes a stem followed by four alternatives or choices from which the student has to choose the correct answer.

Five main areas were specified to be measured by this test. The first concerns *reading the content of mathematical word-problems*, measured by items (1, 2, 3, 4, 5, 6, 7, 8, 9, 10), the second is about *understanding the content of mathematical word-problems,* measured by items (11, 12, 13, 14, 15), the third area is about *converting the digits from verbal to symbolic forms in word-problems*, measured by items (16, 17, 18, 19, 20), the fourth deals with *choosing the appropriate mathematical operation*, measured by items (21, 22, 23, 24), and the fifth and last area is *about arriving at the correct solution to mathematical word-problems*, measured by items (25, 26, 27, 28, 29, 30).

A score is simply the number of answers marked correctly. One mark is given to each correct test item in part one, two marks are given to each correct test item in the other parts of the test. The maximum score for this test is (50) marks.

Students' scores on this test will help answer the following question:

What is the effect of the suggested programme on 4th year primary school pupils' performance in mathematical word-problems?

You are kindly requested to judge the suitability and validity of this test in terms of:

1 - Stating of items.

2 - Whether the item reflects the content of the area measured.

3 - Whether the item measures how far the objective is achieved.

4 - Fitness of the test for the group of study.

Your help and cooperation are greatly appreciated

Sincerely

Meshal Al mansouri

Brunel University
School of Sport and Education

Dear Pupil,

The researcher is conducting a study for a Ph.D. Degree. This research is aimed at measuring the effect of a suggested programme for developing 4th year primary pupils' performance in mathematical word-problems in Kuwait. Attached is a test which is not intended to evaluate your proficiency, but rather to see the effect of the suggested programme. Your scores on this test will help answer the following question:

What is the effect of the suggested programme on your performance in mathematical word-problems?

Your cooperation is greatly appreciated.

Sincerely

Meshal Al mansouri

Brunel University

School of Sport and Education

Pre-post Mathematical Word-problem Achievement Test

Test Directions

1. This is a mathematical word-problem achievement test. It is designed to measure your performance in solving mathematical word-problems.
2. The test is divided into five parts dealing with five different areas of solving mathematical word-problems.
3. It comprises thirty (30) items; ten (10) of which are designed in a matching format and the rest of the items are designed in a multiple choice format. Each item of the multiple choice formatted items includes a stem followed by four alternatives or choices.
4. In part one; match each item in column (a) with the suitable choice from column (b) to form correct words.
5. For each item in the other parts of the test, read the stem carefully then choose the correct answer.
6. Do not spend too much time on any one question.
7. Your score is the number of correct options that you choose; there is no added penalty for wrong answers.
8. You will have (45) minutes to finish this test.
9. If you finish before time is called, you may review your work. Lay your pen down immediately when time is called.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Pre-post Mathematical Word-problem Achievement Test

Pupil's Name:...

Answer the following questions.

Part One

☒ **Match the letters from column (A) with the suitable choice from (B) to form correct words:**

Item No.		Column (A)	Column (B)
(7)		div	Ok
(8)		super	Ool
(9)		bo	Gerators
(10)		pen	D
(11)		sch	Rs
(12)		mult	Market
(13)		refri	Ide
(14)		Ad	Tract
(15)		ca	Iply
(16)		Sub	Cils

Part Two

☒ **Read the following paragraph then answer the questions below. Choose the correct answer from a, b, c or d.**

Fatima went with her friends Mona, Norah and Amal to the garden. There, they played some games together; they played football, basketball, ping pong and tennis. After that, they had lunch together. When finished, they went for a walk downtown where they went shopping.

(17) Where did Fatima go with her friends?

- **(a) to the zoo**
- **(b) to the supermarket**
- **(c) to the cinema**
- **(d) to the garden**

(18) How many friends does Fatima have?

- **(a) two**
- **(b) three**
- **(c) four**
- **(d) one**

(19) How many games did they play together?

- **(a) two**
- **(b) three**
- **(c) four**
- **(d) one**

(20) What did they have together?

- **(a) breakfast**
- **(b) dinner**

(c) lunch

(d) both (a) and (b)

(21) What did they do when they had finished having lunch?

(a) they went for a walk

(b) they went home

(c) they went hiking

(d) all of the above

Part Three

☒ Read the following then convert the numbers included from verbal to symbolic form. Choose the correct answer from a, b, c or d.

(22) Four hundred and ten.

(a) 410

(b) 4100

(c) 41

(d) 3410

(23) Four thousand and fifty.

(a) 450

(b) 4050

(c) 3450

(d) 45

(24) Five million four hundred thousand and sixty one.

(a) 4527

(b) 5461

(c) 859882

(d) 5400061

(25) Twelve thousand and thirty.

- **(a) 12030**
- **(b) 1230**
- **(c) 53430**
- **(d) 1200030**

(26) Eighty nine.

- **(a) 98**
- **(b) 89**
- **(c) 189**
- **(d) 8091**

Part Four

☒ **Read the following problem and determine the appropriate mathematical operation needed. Choose the correct answer from a, b, c or d.**

(27) The number of grade-two pupils at your school is thirty five, while the total number of grade-three pupils is forty six. What is the difference between numbers of the two grades?

The appropriate mathematical operation needed is…………..

(a) addition

(b) subtraction

(c) multiplication

(d) division

(28) Your father's apartment is too big. It has five bedrooms, each bedroom contains two beds. How many beds are there in your father's apartment?

The appropriate mathematical operation needed is…………..

(a) addition

(b) subtraction

(c) multiplication

(d) division

(29) Mohammad's favourite hobby is stamp collection. He has collected 67 stamps since last year. His father gave him a collection of 43 different stamps to be added to his collection. How many stamps does Mohammed actually have?

The appropriate mathematical operation needed is…………..

(a) addition

(b) subtraction

(c) multiplication

(d) division

(30) A teacher brought 84 crayons and distributed them equally among 12 boys. How many crayons does each one get?

The appropriate mathematical operation needed is…………..

(b) addition

(c) subtraction

(d) multiplication

(e) division

Part Five

☒ **Read the following word-problems, then choose the correct solution from a, b, c or d. You may use the last three unlined pages in this test booklet as a draft for your solutions to the given problems.**

(31) Your mathematics teacher asked you to multiply two hundred and twenty five by three hundred and fourteen. What is the correct solution to this problem?

The correct solution to this problem is……..……………

(a) 70650

(b) 70865

(c) 70560

(d) 50670

(32) Meshaal bought a villa for eleven thousand and thirty Kuwaiti Dinars and his brother Saleh bought another one for nine thousand three hundred Kuwaiti Dinars. How much did they pay for both villas together?

The correct solution to this problem is……..……………

(a) 33035 Kuwaiti Dinars

(b) 20430 Kuwaiti Dinars

(c) 30320 Kuwaiti Dinars

(d) 20330 Kuwaiti Dinars

(33) Omar has nine thousand one hundred Kuwaiti Dinars while Mohammed has two hundred and fifty five. What is the difference between what Omar and Mohammed have?

The correct solution to this problem is……..……………

(a) 1285 Kuwaiti Dinars

(b) 8845 Kuwaiti Dinars

(c) 8158 Kuwaiti Dinars

(d) 8485 Kuwaiti Dinars

(34) Gaseem is one hundred and seventy three centimetres tall while Ali is one hundred and sixty five. Who is taller, Gaseem or Ali?

The correct solution to this problem is……..……………

(a) Gaseem is taller than Ali

(b) Ali is taller than Gaseem

(c) Ali is as tall as Gaseem

(d) Non of the above

(35) A father possesses three hundred and twenty four acres of land. Before his death, he wanted to divide them equally between his four children. How many acres will each one of the children take?

The correct solution to this problem is……..……………

- **(a) each one of the children takes 18 acres of land**
- **(b) each one of the children takes 88 acres of land**
- **(c) each one of the children takes 8 acres of land**
- **(d) each one of the children takes 81 acres of land**

(36) Ahmad has eighty five US Dollars while his brother Omar has two hundred and forty five. In order to buy a new bike, Ahmad borrowed his brother's money who agreed to lend him his money as a loan. What is the total sum of money Omar will have by adding his brother's money to his own?

The correct solution to this problem is……..……………

- **(a) 233 US Dollars**
- **(b) 1233 US Dollars**
- **(c) 330 US Dollars**
- **(d) 420 US Dollars**

End of Test

Answer Key

For

Pre-post Mathematical Word-problem Achievement Test

Item No.	**Answer**
Part One	
1	**7**
2	**6**
3	**1**
4	**10**
5	**2**
6	**9**
7	**3**
8	**4**
9	**5**
10	**8**
Part Two	
11	**d**
12	**b**
13	**c**
14	**c**
15	**a**
Part Three	
16	**a**
17	**b**
18	**d**
19	**a**
20	**b**
Part Four	

21	**b**
22	**c**
23	**a**
24	**d**
Part Five	
25	**a**
26	**d**
27	**b**
28	**a**
29	**d**
30	**c**

Appendix (5)

MATHEMATICAL WORD-PROBLEM ATTITUDE SCALE

Brunel University

School of Sport and Education

Dear Jury Member,

The researcher is conducting a study for a Ph.D. Degree. This research is aimed at measuring the effect of a suggested programme for developing 4th year primary pupils' performance in mathematical word-problems in Kuwait.

Attached is a scale for identifying 4th year primary school pupils' attitudes towards mathematical word-problems before and after studying the suggested programme.

You are kindly requested to judge the suitability and validity of this scale in terms of:

1 - Stating of items.

2 - Fitness of the items for the group of study.

Your valuable comments on this scale will help answer the following question:

What are 4th year primary school pupils' attitudes towards mathematical word-problems before and after studying the suggested programme?

Your help and cooperation are greatly appreciated

Sincerely

Meshal Al mansouri

Brunel University

School of sport and education

Dear Pupil,

The researcher is conducting a study for a Ph.D. Degree. This research is aimed at measuring the effect of a suggested programme for developing 4^{th} year primary pupils' performance in mathematical word-problems in Kuwait.

Attached is a scale for identifying your attitudes towards mathematical word-problems.

Your scores on this scale will help answer the following question:

What are your attitudes towards mathematical word-problems?

Your cooperation is greatly appreciated.

Sincerely

Meshal Al mansouri

Brunel University

School of Sport and education

<u>Mathematical Word-problem Attitude Scale</u>

<u>Directions</u>

6. The scale comprises (24) statements.

7. You are kindly asked to respond to all the statements.

8. There is no right or wrong answer to these statements.

9. Time allowed is about (30) minutes.

10. Each of the statements below expresses a feeling toward mathematical word-problems. Please read each statement and mark the one response **a, b, c, d,** or **e** that really tells your actual feeling.

11. As you read the statements, you will know whether you agree or disagree. If you strongly agree, *circle A* next to the given statement. If you agree, but not so strongly, or you only "sort of" agree, *circle B*. If you strongly disagree with the given statement, *circle E*. If you disagree, but not so strongly, *circle D*. If you are not sure about a given statement or you cannot rate it, *circle C*.

(f) Strongly agree

(g) Agree

(h) Undecided

(i) Disagree

(j) Strongly disagree

12. Answer in terms of <u>how well the statement describes your feeling</u>. Do not answer in terms of <u>how you think your feeling should be</u>, or what <u>other pupils' feelings are</u>.

13. If you have any questions, let the researcher know immediately.

Your cooperation is greatly appreciated.

Yours

Meshal Al mansouri

MATHEMATICAL WORD-PROBLEM ATTITUDE SCALE

--

Each of the statements below expresses a feeling toward mathematical word-problems. Please rate each statement in terms of the extent to which you agree.

No.	Statement	(A) Strongly agree	(B) Agree	(C) Undecided	(D) Disagree	(E) Strongly Disagree
(1)	Mathematical word-problems are very interesting to me.					
(2)	I do not like mathematical word-problems, and it scares me to study them.					
(3)	I am always under a terrible strain in a mathematical word-problem class.					
(4)	Mathematical word-problems are fascinating and fun.					
(5)	Mathematical word-problems make me feel secure, and at the same time are stimulating.					
(6)	Mathematical word-problems make me feel uncomfortable, restless, irritable, and impatient.					
(7)	In general, I have a good feeling toward mathematical word-problems.					
(8)	When I hear the words 'mathematical word-problems', I have a feeling of dislike.					
(9)	I approach mathematical word-problems with a feeling of hesitation.					
(10)	I really like mathematical word-problems.					
(11)	I always enjoy studying mathematical word-problems in school.					

(12)	It makes me nervous to even think about solving a mathematical word-problem.					
(13)	I do not feel at ease with mathematical word-problems.					
(14)	I feel a definite positive reaction to mathematical word-problems; they are enjoyable.					
(15)	I experience no difficulty in reading mathematical word-problems.					
(16)	Reading mathematical word-problems is very difficult for me.					
(17)	Understanding the content of mathematical word-problems is easy for me.					
(18)	Mathematical word-problems are always confusing and difficult for me to understand.					
(19)	It is easy for me to convert the digits from verbal to symbolic forms in mathematical word-problems.					
(20)	It is always difficult for me to convert the digits from verbal to symbolic forms in mathematical word-problems.					
(21)	I can easily decide on the appropriate mathematical operations when solving mathematical word-problems.					
(22)	Deciding on the appropriate mathematical operation required to solve a mathematical word-problem is always difficult for me.					
(23)	I can confidently arrive at the correct solution to mathematical word-problems.					
(24)	I always feel suspicious about my solutions to mathematical word-problems.					

End of the Scale

Appendix (6)

Tables of the Raw Scores of the Study Subjects

Table (35)

Frequencies of the 4th Year Primary School Mathematics Teachers' Responses to Each Option of the Needs Assessment Questionnaire Regarding Different Areas of Difficulty

Item No.	Areas of Difficulty	Subjects	Options				
			(A) Extremely disagree	(B) Moderately disagree	(C) Somewhat agree	(D) Moderately agree	(e) Extremely agree
1	**Reading the content of mathematical word problems.**	80	10	10	30	10	20
2	**Understanding the content of mathematical word problems.**	80	0	0	15	30	35
3	**Converting the digits from verbal to symbolic forms in mathematical word problems.**	80	10	15	10	15	30
4	**Choosing the appropriate mathematical operations in solving mathematical word problems.**	80	0	0	9	38	33
5	**Arriving at the correct solution to mathematical word problems.**	80	0	0	5	28	47

Table (36)

Raw Scores of the Control group Pupils in the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Total Score	Student-Boy No.	Total Score
1	21	26	24
2	28	27	26
3	19	28	22
4	20	29	25
5	25	30	18
6	20	31	18
7	22	32	22
8	20	33	27
9	24	34	25
10	21	35	24
11	28	36	20
12	20	37	23
13	26	38	25
14	22	39	20
15	22	40	25
16	24	41	20
17	17	42	16
18	25	43	25
19	26	44	21
20	24	45	27
21	19	46	23
22	27	47	25
23	25	48	26
24	24	49	21
25	22	50	21

Table (37)

Raw Scores of the Control group Pupils in Part One of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	5	26	4
2	6	27	4
3	5	28	6
4	4	29	5
5	5	30	4
6	4	31	4
7	6	32	6
8	4	33	3
9	8	34	5
10	5	35	6
11	4	36	4
12	4	37	5
13	6	38	7
14	4	39	4
15	4	40	5
16	6	41	4
17	5	42	4
18	7	43	5
19	6	44	5
20	4	45	7
21	3	46	5
22	5	47	7
23	7	48	6
24	6	49	5
25	4	50	5

Table (38)

Raw Scores of the Control group Pupils in Part Two of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	6
2	6	27	6
3	4	28	4
4	6	29	4
5	4	30	2
6	4	31	2
7	6	32	4
8	4	33	6
9	2	34	6
10	4	35	4
11	6	36	6
12	4	37	4
13	4	38	4
14	2	39	6
15	6	40	6
16	6	41	2
17	2	42	4
18	4	43	6
19	4	44	4
20	4	45	4
21	4	46	4
22	6	47	6
23	6	48	4
24	6	49	4
25	6	50	2

Table (39)

Raw Scores of the Control group Pupils in Part Three of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	6	26	4
2	6	27	6
3	4	28	4
4	2	29	6
5	4	30	4
6	4	31	4
7	4	32	4
8	4	33	6
9	4	34	4
10	4	35	4
11	6	36	4
12	4	37	2
13	6	38	4
14	4	39	4
15	4	40	6
16	4	41	6
17	2	42	2
18	4	43	4
19	6	44	6
20	6	45	6
21	6	46	6
22	6	47	2
23	4	48	4
24	2	49	4
25	4	50	6

Table (40)

Raw Scores of the Control group Pupils in Part Four of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	2	26	4
2	4	27	4
3	2	28	4
4	4	29	4
5	6	30	4
6	4	31	4
7	2	32	2
8	2	33	6
9	4	34	4
10	4	35	4
11	6	36	2
12	4	37	4
13	4	38	6
14	6	39	2
15	4	40	4
16	2	41	2
17	2	42	2
18	4	43	4
19	6	44	2
20	4	45	4
21	2	46	2
22	4	47	4
23	2	48	6
24	4	49	2
25	2	50	2

Table (41)

Raw Scores of the Control group Pupils in Part Five of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	6
2	6	27	6
3	4	28	6
4	4	29	6
5	6	30	4
6	4	31	4
7	4	32	6
8	6	33	6
9	6	34	6
10	4	35	6
11	6	36	4
12	4	37	8
13	6	38	4
14	6	39	4
15	4	40	4
16	6	41	6
17	6	42	4
18	6	43	6
19	4	44	4
20	6	45	6
21	4	46	6
22	6	47	6
23	6	48	6
24	6	49	6
25	6	50	6

Table (42)

Raw Scores of the Experimental group Pupils in the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Total Score	Student-Boy No.	Total Score
1	27	26	26
2	27	27	22
3	20	28	18
4	22	29	24
5	24	30	29
6	24	31	25
7	21	32	20
8	18	33	22
9	23	34	21
10	20	35	25
11	18	36	23
12	20	37	19
13	23	38	26
14	26	39	22
15	27	40	26
16	24	41	25
17	21	42	21
18	26	43	23
19	27	44	24
20	28	45	28
21	25	46	25
22	25	47	17
23	20	48	25
24	23	49	25
25	26	50	18

Table (43)

Raw Scores of the Experimental group Pupils in Part One of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	5	26	6
2	5	27	4
3	4	28	4
4	6	29	6
5	4	30	5
6	6	31	5
7	5	32	4
8	4	33	4
9	5	34	7
10	4	35	5
11	6	36	7
12	4	37	3
13	7	38	4
14	6	39	4
15	5	40	4
16	4	41	5
17	5	42	5
18	8	43	5
19	5	44	6
20	8	45	6
21	5	46	3
22	7	47	3
23	4	48	7
24	5	49	7
25	6	50	4

Table (44)

Raw Scores of the Experimental group Pupils in Part Two of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	6	26	4
2	4	27	6
3	4	28	2
4	4	29	6
5	6	30	8
6	4	31	8
7	4	32	2
8	2	33	2
9	6	34	6
10	4	35	6
11	2	36	4
12	2	37	4
13	4	38	6
14	6	39	2
15	6	40	6
16	6	41	6
17	4	42	4
18	4	43	4
19	8	44	4
20	4	45	6
21	4	46	6
22	4	47	2
23	6	48	2
24	4	49	4
25	4	50	4

Table (45)

Raw Scores of the Experimental group Pupils in Part Three of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	6
2	6	27	4
3	2	28	4
4	4	29	4
5	6	30	6
6	4	31	2
7	6	32	6
8	2	33	6
9	6	34	2
10	4	35	6
11	2	36	4
12	4	37	4
13	4	38	6
14	6	39	4
15	4	40	6
16	6	41	6
17	2	42	4
18	4	43	4
19	6	44	6
20	6	45	6
21	4	46	4
22	6	47	2
23	4	48	6
24	4	49	4
25	6	50	4

Table (46)

Raw Scores of the Experimental group Pupils in Part Four of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	4
2	6	27	4
3	4	28	2
4	4	29	4
5	2	30	6
6	4	31	4
7	2	32	4
8	4	33	2
9	2	34	2
10	4	35	4
11	4	36	4
12	4	37	4
13	4	38	6
14	2	39	6
15	4	40	4
16	4	41	2
17	4	42	2
18	2	43	4
19	4	44	4
20	6	45	4
21	4	46	4
22	2	47	4
23	2	48	4
24	4	49	2
25	4	50	2

Table (47)

Raw Scores of the Experimental group Pupils in Part Five of the Pre Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	26	6
2	6	27	4
3	6	28	6
4	4	29	4
5	6	30	4
6	6	31	6
7	4	32	4
8	6	33	6
9	4	34	4
10	4	35	4
11	4	36	4
12	6	37	4
13	4	38	4
14	6	39	6
15	8	40	6
16	4	41	6
17	6	42	6
18	8	43	6
19	4	44	4
20	4	45	6
21	8	46	8
22	6	47	6
23	4	48	6
24	6	49	8
25	6	50	4

Table (48)

Raw Scores of the Control group Pupils in the Post Mathematical word Problem Achievement Test

Student-Girl No.	Total Score	Student-Boy No.	Total Score
1	24	26	24
2	21	27	19
3	25	28	28
4	20	29	29
5	24	30	20
6	27	31	23
7	22	32	20
8	21	33	24
9	20	34	22
10	18	35	22
11	22	36	23
12	27	37	23
13	24	38	27
14	19	39	22
15	24	40	22
16	22	41	21
17	23	42	18
18	26	43	27
19	24	44	23
20	24	45	27
21	21	46	25
22	28	47	23
23	20	48	24
24	25	49	19
25	21	50	20

Table (49)

Raw Scores of the Control group Pupils in Part One of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	6
2	5	27	3
3	5	28	6
4	4	29	7
5	6	30	4
6	7	31	5
7	6	32	4
8	5	33	4
9	6	34	6
10	4	35	6
11	4	36	5
12	7	37	3
13	4	38	7
14	5	39	4
15	6	40	2
16	4	41	5
17	5	42	6
18	6	43	5
19	6	44	5
20	6	45	7
21	3	46	5
22	4	47	5
23	4	48	6
24	5	49	3
25	5	50	4

Table (50)

Raw Scores of the Control group Pupils in Part Two of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	6	26	4
2	4	27	4
3	4	28	6
4	4	29	6
5	6	30	6
6	6	31	4
7	2	32	4
8	4	33	6
9	4	34	4
10	4	35	2
11	4	36	4
12	4	37	4
13	6	38	6
14	2	39	4
15	6	40	6
16	4	41	6
17	4	42	2
18	6	43	6
19	4	44	4
20	6	45	6
21	4	46	4
22	6	47	4
23	4	48	4
24	6	49	2
25	6	50	4

Table (51)

Raw Scores of the Control group Pupils in Part Three of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	6
2	6	27	4
3	6	28	4
4	4	29	4
5	4	30	4
6	6	31	6
7	4	32	4
8	4	33	4
9	2	34	4
10	4	35	6
11	4	36	6
12	4	37	4
13	6	38	4
14	4	39	6
15	4	40	6
16	4	41	2
17	6	42	2
18	4	43	6
19	6	44	6
20	4	45	4
21	6	46	6
22	6	47	4
23	4	48	4
24	4	49	4
25	2	50	4

Table (52)

Raw Scores of the Control group Pupils in Part Four of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	4	26	4
2	2	27	2
3	6	28	6
4	2	29	4
5	2	30	2
6	4	31	4
7	4	32	4
8	2	33	4
9	4	34	4
10	2	35	2
11	4	36	2
12	4	37	4
13	2	38	6
14	4	39	2
15	2	40	4
16	4	41	4
17	4	42	4
18	4	43	4
19	4	44	2
20	4	45	4
21	4	46	4
22	6	47	4
23	4	48	4
24	4	49	4
25	4	50	4

Table (53)

Raw Scores of the Control group Pupils in Part Five of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	6	26	4
2	4	27	6
3	4	28	6
4	6	29	8
5	6	30	4
6	4	31	4
7	6	32	4
8	6	33	6
9	4	34	4
10	4	35	6
11	6	36	6
12	8	37	8
13	6	38	4
14	4	39	6
15	6	40	4
16	6	41	4
17	4	42	4
18	6	43	6
19	4	44	6
20	4	45	6
21	4	46	6
22	6	47	6
23	4	48	6
24	6	49	6
25	4	50	4

Table (54)

Raw Scores of the Experimental group Pupils in the Post Mathematical word Problem Achievement Test

Student-Girl No.	Total Score	Student-Boy No.	Total Score
1	38	26	33
2	41	27	37
3	27	28	32
4	38	29	31
5	33	30	28
6	39	31	33
7	31	32	31
8	36	33	38
9	33	34	37
10	33	35	36
11	38	36	35
12	33	37	37
13	32	38	29
14	36	39	34
15	37	40	35
16	34	41	32
17	35	42	33
18	30	43	32
19	32	44	32
20	35	45	31
21	40	46	33
22	37	47	33
23	32	48	36
24	38	49	37
25	40	50	37

Table (55)

Raw Scores of the Experimental group Pupils in Part One of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	26	7
2	7	27	7
3	7	28	8
4	8	29	7
5	7	30	8
6	7	31	7
7	7	32	7
8	6	33	8
9	7	34	7
10	7	35	6
11	8	36	7
12	7	37	7
13	8	38	7
14	6	39	6
15	7	40	7
16	8	41	6
17	7	42	7
18	6	43	6
19	6	44	6
20	7	45	7
21	8	46	7
22	7	47	7
23	6	48	6
24	8	49	7
25	8	50	7

Table (56)

Raw Scores of the Experimental group Pupils in Part Two of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	26	6
2	8	27	8
3	6	28	8
4	8	29	6
5	6	30	8
6	8	31	6
7	6	32	6
8	6	33	8
9	8	34	8
10	6	35	8
11	6	36	6
12	6	37	6
13	8	38	6
14	8	39	8
15	6	40	8
16	6	41	6
17	6	42	8
18	6	43	6
19	6	44	6
20	8	45	6
21	6	46	8
22	8	47	6
23	6	48	6
24	6	49	8
25	8	50	6

Table (57)

Raw Scores of the Experimental group Pupils in Part Three of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	26	8
2	8	27	6
3	4	28	6
4	6	29	6
5	6	30	6
6	8	31	6
7	6	32	6
8	8	33	8
9	6	34	8
10	8	35	8
11	8	36	6
12	8	37	8
13	6	38	6
14	8	39	6
15	8	40	8
16	6	41	6
17	8	42	8
18	4	43	6
19	8	44	8
20	6	45	6
21	8	46	6
22	8	47	8
23	8	48	8
24	8	49	8
25	6	50	8

Table (58)

Raw Scores of the Experimental group Pupils in Part Four of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	6	26	6
2	8	27	6
3	4	28	4
4	6	29	6
5	4	30	4
6	6	31	6
7	4	32	4
8	6	33	6
9	4	34	6
10	4	35	6
11	6	36	6
12	4	37	8
13	4	38	4
14	6	39	6
15	6	40	4
16	6	41	6
17	6	42	4
18	4	43	6
19	6	44	6
20	6	45	4
21	8	46	6
22	6	47	4
23	6	48	6
24	8	49	6
25	8	50	8

Table (59)

Raw Scores of the Experimental group Pupils in Part Five of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	26	6
2	10	27	10
3	6	28	6
4	10	29	6
5	10	30	8
6	10	31	8
7	8	32	8
8	10	33	6
9	8	34	8
10	8	35	8
11	10	36	10
12	8	37	8
13	6	38	6
14	8	39	8
15	10	40	8
16	8	41	8
17	8	42	6
18	10	43	8
19	6	44	6
20	8	45	8
21	10	46	6
22	8	47	8
23	6	48	10
24	8	49	8
25	10	50	8

Table (60)

Raw Scores of the Girls versus Boys of the Experimental group Pupils in the Post Mathematical word Problem Achievement Test

Student-Girl No.	Total Score	Student-Boy No.	Total Score
1	38	1	33
2	41	2	37
3	27	3	32
4	38	4	31
5	33	5	28
6	39	6	33
7	31	7	31
8	36	8	38
9	33	9	37
10	33	10	36
11	38	11	35
12	33	12	37
13	32	13	29
14	36	14	34
15	37	15	35
16	34	16	32
17	35	17	33
18	30	18	32
19	32	19	32
20	35	20	31
21	40	21	33
22	37	22	33
23	32	23	36
24	38	24	37
25	40	25	37

Table (61)

Raw Scores of the Girls versus Boys of the Experimental group Pupils in Part One of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	1	7
2	7	2	7
3	7	3	8
4	8	4	7
5	7	5	8
6	7	6	7
7	7	7	7
8	6	8	8
9	7	9	7
10	7	10	6
11	8	11	7
12	7	12	7
13	8	13	7
14	6	14	6
15	7	15	7
16	8	16	6
17	7	17	7
18	6	18	6
19	6	19	6
20	7	20	7
21	8	21	7
22	7	22	7
23	6	23	6
24	8	24	7
25	8	25	7

Table (62)

Raw Scores of the Girls versus Boys of the Experimental group Pupils in Part Two of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	1	6
2	8	2	8
3	6	3	8
4	8	4	6
5	6	5	8
6	8	6	6
7	6	7	6
8	6	8	8
9	8	9	8
10	6	10	8
11	6	11	6
12	6	12	6
13	8	13	6
14	8	14	8
15	6	15	8
16	6	16	6
17	6	17	8
18	6	18	6
19	6	19	6
20	8	20	6
21	6	21	8
22	8	22	6
23	6	23	6
24	6	24	8
25	8	25	6

Table (63)

Raw Scores of the Girls versus Boys of the Experimental group Pupils in Part Three of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	1	8
2	8	2	6
3	4	3	6
4	6	4	6
5	6	5	6
6	8	6	6
7	6	7	6
8	8	8	8
9	6	9	8
10	8	10	8
11	8	11	6
12	8	12	8
13	6	13	6
14	8	14	6
15	8	15	8
16	6	16	6
17	8	17	8
18	4	18	6
19	8	19	8
20	6	20	6
21	8	21	6
22	8	22	8
23	8	23	8
24	8	24	8
25	6	25	8

Table (64)

Raw Scores of the Girls versus Boys of the Experimental group Pupils in Part Four of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	6	1	6
2	8	2	6
3	4	3	4
4	6	4	6
5	4	5	4
6	6	6	6
7	4	7	4
8	6	8	6
9	4	9	6
10	4	10	6
11	6	11	6
12	4	12	8
13	4	13	4
14	6	14	6
15	6	15	4
16	6	16	6
17	6	17	4
18	4	18	6
19	6	19	6
20	6	20	4
21	8	21	6
22	6	22	4
23	6	23	6
24	8	24	6
25	8	25	8

Table (65)

Raw Scores of the Girls versus Boys of the Experimental group Pupils in Part Five of the Post Mathematical word Problem Achievement Test

Student-Girl No.	Score	Student-Boy No.	Score
1	8	1	6
2	10	2	10
3	6	3	6
4	10	4	6
5	10	5	8
6	10	6	8
7	8	7	8
8	10	8	6
9	8	9	8
10	8	10	8
11	10	11	10
12	8	12	8
13	6	13	6
14	8	14	8
15	10	15	8
16	8	16	8
17	8	17	6
18	10	18	8
19	6	19	6
20	8	20	8
21	10	21	6
22	8	22	8
23	6	23	10
24	8	24	8
25	10	25	8

Table (66)

Frequencies of the 4th Year Primary School Pupils' Responses to Each Option of the Attitude Scale Regarding Their feelings towards mathematical word problems in the Pre-Measurement

No.	Subjects	Statement	(A) Strongly agree	(B) Agree	(C) Be undecided	(D) Disagree	(E) Strongly Disagree	Total Score
(1)	**50**	Mathematical word problems are very interesting to me.	2	5	1	16	26	91
(2)	**50**	I don't like mathematical word problems, and it scares me to study them.	25	16	6	3	0	87
(3)	**50**	I am always under a terrible strain in a mathematical word problem class.	23	19	5	3	0	88
(4)	**50**	Mathematical word problems are fascinating and fun.	0	2	10	18	20	94
(5)	**50**	Mathematical word problems make me feel secure, and at the same time are stimulating.	0	0	6	17	27	79
(6)	**50**	Mathematical word problems make	28	12	5	3	2	89

		me feel uncomfortable, restless, irritable, and impatient.						
(7)	**50**	In general, I have a good feeling toward mathematical word problems.	1	2	4	13	30	81
(8)	**50**	When I hear the worlds "mathematical word problems," I have a feeling of dislike.	0	4	6	16	24	90
(9)	**50**	I approach mathematical word problems with a feeling of hesitation.	18	18	10	3	1	101
(10)	**50**	I really like mathematical word problems.	1	2	3	12	32	78
(11)	**50**	I always enjoy studying mathematical word problems in school.	0	2	12	17	19	97
(12)	**50**	It makes me nervous to even think about solving a mathematical word problem.	26	14	4	6	0	90
(13)	**50**	I do not feel at ease in mathematical word problems.	32	8	4	5	1	85
(14)	**50**	I feel a definite positive reaction to mathematical word problems; they are enjoyable.	1	1	11	19	18	98
(15)	**50**	I experience no difficulty in reading mathematical word problems.	0	3	4	15	28	82
(16)	**50**	Reading mathematical word problems	27	14	4	5	0	87

		is very difficult for me.						
(17)	**50**	Understanding the content of mathematical word problems is easy for me.	0	3	9	17	21	94
(18)	**50**	Mathematical word problems are always confusing and difficult for me to understand.	33	8	4	5	0	61
(19)	**50**	It is easy for me to convert the digits from verbal to symbolic forms in mathematical word problems.	0	3	9	15	23	92
(20)	**50**	It is always difficult for me to convert the digits from verbal to symbolic forms in mathematical word problems.	30	12	4	4	0	82
(21)	**50**	I can easily decide the appropriate mathematical operations in solving mathematical word problems.	0	1	5	16	28	79
(22)	**50**	Deciding on the appropriate mathematical operation required to solve a mathematical word-problem is always difficult for me.	28	16	2	3	1	83
(23)	**50**	I can confidently arrive at the correct solution to mathematical word problems.	2	4	2	17	25	91

(24)	**50**	I always feel suspicious about my solutions to mathematical word problems.	0	3	4	12	31	79

End of the Scale

Table (67)

Frequencies of the 4th Year Primary School Pupils' Responses to Each Option of the Attitude Scale Regarding Their Feelings towards Mathematical Word Problems in the Post-Measurement

Item No.	Subjects	Statement	(A) Strongly agree	(B) Agree	(C) Be undecided	(D) Disagree	(E) Strongly Disagree	Total Score
(1)	**50**	Mathematical word problems are very interesting to me.	26	16	1	5	2	209
(2)	**50**	I don't like mathematical word problems, and it scares me to study them.	0	2	7	15	26	215
(3)	**50**	I am always under a terrible strain in a mathematical word problem class.	1	3	4	12	30	205
(4)	**50**	Mathematical word problems are fascinating and fun.	28	16	4	2	0	220
(5)	**50**	Mathematical word problems make me feel secure, and at the same time are stimulating.	26	14	5	3	2	209

(6)	**50**	Mathematical word problems make me feel uncomfortable, restless, irritable, and impatient.	0	2	3	15	30	223
(7)	**50**	In general, I have a good feeling toward mathematical word problems.	28	17	3	2	0	221
(8)	**50**	When I hear the worlds "mathematical word problems," I have a feeling of dislike.	0	3	7	16	24	211
(9)	**50**	I approach mathematical word problems with a feeling of hesitation.	0	2	8	14	26	214
(10)	**50**	I really like mathematical word problems.	30	14	3	3	0	221
(11)	**50**	I always enjoy studying mathematical word problems in school.	19	17	13	1	0	204
(12)	**50**	It makes me nervous to even think about solving a mathematical word problem.	1	2	3	14	30	219
(13)	**50**	I do not feel at ease in mathematical word problems.	2	4	3	10	31	214
(14)	**50**	I feel a definite positive reaction to mathematical word problems; they are enjoyable.	20	17	12	1	0	206
(15)	**50**	I experience no difficulty in reading mathematical word problems.	28	13	4	4	1	212

(16)	**50**	Reading mathematical word problems is very difficult for me.	1	2	4	13	30	219
(17)	**50**	Understanding the content of mathematical word problems is easy for me.	25	15	5	5	0	210
(18)	**50**	Mathematical word problems are always confusing and difficult for me to understand.	28	12	5	4	1	212
(19)	**50**	It is easy for me to convert the digits from verbal to symbolic forms in mathematical word problems.	22	15	8	4	1	203
(20)	**50**	It is always difficult for me to convert the digits from verbal to symbolic forms in mathematical word problems.	0	3	3	16	28	219
(21)	**50**	I can easily decide the appropriate mathematical operations in solving mathematical word problems.	20	15	5	5	5	190
(22)	**50**	Deciding on the appropriate mathematical operation required to solve a mathematical word-problem is always difficult for me.	2	3	3	12	30	215
(23)	**50**	I can confidently arrive at the correct solution to mathematical word	27	16	5	2	0	218

		problems.						
(24)	**50**	I always feel suspicious about my solutions to mathematical word problems.	0	4	3	12	31	218

End of the Scale

Table (68)

Raw scores of the pupils of the pilot study sample in the two administrations of the needs assessment questionnaire for calculating its reliability

N.	Item (1)	Item (2)	Item (3)	Item (4)	Item (5)		N.	Item (1)	Item (2)	Item (3)	Item (4)	Item (5)
1	0	2	0	2	2		1	0	2	1	3	3
2	1	3	1	2	2		2	1	3	2	2	2
3	2	3	2	3	3		3	2	3	2	3	4
4	2	4	2	4	3		4	2	4	2	2	2
5	3	2	3	3	4		5	2	2	2	2	4
6	1	4	1	3	2		6	1	3	0	4	2
7	3	4	3	4	4		7	3	4	2	4	4
8	2	4	2	4	3		8	2	4	1	4	3
9	2	3	2	4	3		9	1	3	1	4	3
10	3	3	4	4	3		10	3	4	3	4	3
11	4	3	4	4	4		11	4	4	3	4	4
12	0	2	1	4	2		12	4	2	2	2	2
13	4	4	3	2	4		13	4	4	3	4	4
14	1	2	4	4	2		14	1	2	3	3	2
15	4	3	3	2	4		15	4	3	3	4	4
16	2	2	2	4	3		16	2	2	3	4	4
17	2	4	2	2	3		17	2	4	1	3	4
18	0	2	0	2	4		18	0	2	2	4	4
19	4	3	3	4	4		19	4	2	4	4	4
20	1	4	2	2	2		20	3	4	3	2	3
21	2	2	2	3	4		21	2	3	4	2	4
22	3	3	3	4	4		22	2	3	4	3	4
23	3	4	4	4	4		23	3	4	4	3	4
24	2	2	2	3	4		24	2	4	4	3	4
25	4	4	4	4	4		25	3	4	4	4	4
26	4	4	4	4	4		26	4	4	4	4	4
27	4	4	4	4	4		27	3	4	4	4	4
28	3	4	3	3	4		28	2	4	4	3	4
29	2	4	2	3	4		29	2	4	0	4	3
30	2	4	2	2	2		30	3	4	2	4	4

Table (69)

Raw scores of the pupils of the pilot study sample in the two administrations of the pre-post mathematics achievement test for calculating its reliability

N.	Part (1)	Part (2)	Part (3)	Part (4)	Part (5)	Total Score	N.	Part (1)	Part (2)	Part (3)	Part (4)	Part (5)	Total Score
1	3	4	4	2	6	19	1	3	6	4	2	6	21
2	5	6	4	4	4	23	2	6	6	6	4	4	26
3	5	4	2	4	5	20	3	5	4	2	4	5	20
4	6	4	4	2	4	20	4	7	4	4	2	4	21
5	5	2	4	2	4	17	5	6	4	4	2	4	20
6	4	4	6	2	4	20	6	6	4	4	2	6	22
7	5	4	4	4	4	21	7	5	4	4	4	4	21
8	6	6	6	4	5	27	8	6	4	6	4	4	24
9	7	6	4	4	6	27	9	7	6	4	4	4	25
10	5	4	2	4	4	19	10	6	4	2	4	6	22
11	7	6	4	2	4	23	11	7	4	4	2	4	21
12	5	2	4	4	6	21	12	5	2	4	4	6	21
13	4	4	4	4	4	20	13	6	4	6	4	4	24
14	3	6	4	4	4	21	14	3	6	4	4	4	21
15	7	4	4	2	6	23	15	8	4	6	2	6	26
16	8	4	6	4	6	28	16	7	4	6	4	6	27
17	6	4	2	2	4	18	17	6	4	4	2	4	20
18	4	4	4	4	6	22	18	4	4	4	2	6	20
19	4	4	2	4	2	16	19	4	4	2	4	2	16
20	6	4	6	2	2	20	20	8	4	6	4	4	26
21	5	4	4	4	4	21	21	6	4	6	4	4	24
22	4	6	4	2	4	20	22	4	6	2	6	4	22
23	6	6	6	4	2	24	23	8	6	6	4	4	28
24	8	6	8	6	6	34	24	7	6	8	6	8	35
25	4	6	6	4	8	28	25	6	4	6	4	6	26
26	6	2	4	4	6	22	26	7	4	6	4	6	27
27	4	6	4	2	4	20	27	4	6	4	2	4	20
28	3	6	8	4	4	25	28	3	6	8	4	4	25
29	7	4	4	4	6	25	29	6	6	4	4	6	26
30	4	4	6	2	6	22	30	6	4	4	4	6	24

Table (70)

Raw scores of the pupils of the pilot study sample in the first administration of the attitude scale for calculating its reliability

						Items																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total Score
1	2	2	2	3	1	3	2	3	3	3	2	2	2	3	3	3	3	3	2	3	2	2	3	2	59
2	4	4	4	5	3	5	3	4	5	3	3	3	4	4	4	4	4	4	4	4	3	4	4	4	93
3	3	3	4	3	3	4	4	3	4	4	5	3	3	3	3	3	2	4	3	4	2	3	3	3	79
4	1	1	2	1	1	2	2	2	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	30
5	5	5	4	4	3	3	2	4	3	2	3	4	5	4	4	4	4	4	5	5	4	5	4	5	95
6	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	2	1	2	1	2	1	2	1	1	30
7	1	1	1	1	1	1	1	1	1	2	1	1	2	1	2	2	1	2	2	1	1	1	1	1	30
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	2	1	1	27
10	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	27
11	2	2	1	2	1	2	1	2	3	1	2	2	2	2	2	1	1	2	2	2	2	2	2	2	43
12	4	5	5	4	4	4	5	4	5	5	5	5	4	4	4	4	4	4	4	4	3	4	3	3	100
13	1	2	2	2	2	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	1	44
14	1	2	2	2	2	2	2	3	2	2	2	2	2	2	1	2	2	2	2	2	1	2	1	1	44
15	2	2	2	2	2	2	2	2	2	1	2	2	2	2	1	2	2	2	2	2	1	1	2	2	44
16	3	3	3	2	2	2	2	1	2	2	2	3	3	2	2	2	2	3	3	2	3	3	2	3	57
17	4	4	5	4	3	5	3	3	3	4	4	4	4	4	4	3	4	2	4	4	3	4	4	4	90
18	2	2	2	2	2	2	2	2	2	3	2	2	3	2	3	2	2	3	2	3	2	2	3	3	55
19	2	1	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	45
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	26
21	1	1	1	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	2	2	30
22	2	2	2	2	1	2	1	2	2	1	1	2	2	2	1	2	2	2	2	2	2	2	2	2	43
23	2	3	2	3	3	2	2	3	3	3	3	2	3	2	3	4	3	2	3	3	3	3	2	3	65
24	2	2	2	2	2	3	1	2	2	1	3	2	2	2	2	2	2	2	1	2	2	2	2	2	47
25	1	2	1	1	1	1	2	1	1	1	2	1	1	2	2	2	2	2	1	1	2	2	2	2	36
26	2	2	2	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	29
27	1	1	2	1	3	2	2	2	2	3	2	2	2	1	2	2	1	2	2	2	2	2	2	1	44
28	2	2	1	3	2	2	1	2	1	2	2	2	2	3	3	2	2	2	2	2	2	2	2	3	49
29	1	1	1	2	2	2	2	2	1	2	2	2	1	2	1	1	2	1	1	2	1	1	2	2	37
30	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	1	2	2	3	2	3	50

Table (71)

Raw scores of the pupils of the pilot study sample in the second administration of the attitude scale for calculating its reliability

	Items																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total Score
1	3	2	3	2	2	3	2	3	3	2	3	3	2	3	3	3	2	3	2	3	2	2	3	2	61
2	4	4	4	4	4	5	4	4	5	5	5	3	4	4	4	5	3	4	4	4	5	4	4	5	101
3	2	3	4	3	3	2	2	4	2	2	2	5	5	2	3	1	2	5	3	4	2	2	3	4	70
4	1	2	1	1	1	1	1	1	1	1	1	1	2	1	2	2	2	2	1	2	1	3	2	2	35
5	5	5	5	5	3	4	2	4	4	3	3	5	5	3	5	5	4	5	5	5	5	5	5	5	105
6	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	26
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24
8	1	1	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	27
9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	26
10	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	2	1	1	1	2	1	2	1	1	29
11	2	2	2	2	1	2	2	2	2	1	2	2	2	1	3	2	1	2	2	2	2	2	2	3	46
12	4	5	5	4	5	5	5	3	5	4	5	3	3	5	5	5	5	4	4	5	4	5	5	5	108
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	25
14	1	1	1	2	1	1	1	1	1	2	1	2	1	2	1	1	2	2	1	2	1	2	2	3	35
15	2	2	2	2	2	2	2	2	2	2	2	3	2	2	1	2	2	2	2	2	1	1	1	2	45
16	4	3	4	3	4	4	4	3	3	4	2	3	4	3	2	1	2	3	3	2	3	2	3	3	72
17	4	3	4	4	4	3	2	2	3	2	4	4	4	4	3	3	3	2	3	4	3	3	3	4	78
18	1	1	1	1	1	1	1	1	2	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	28
19	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	47
20	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1	1	1	1	1	1	1	27
21	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	26
22	2	2	2	2	2	2	2	2	2	1	1	1	2	2	1	1	1	2	2	2	2	2	2	2	42
23	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25
24	2	1	2	2	1	2	2	1	2	1	2	2	1	2	1	2	2	2	1	3	2	2	2	2	42
25	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	25
26	1	2	2	1	1	2	1	1	2	1	2	2	2	1	1	1	1	1	1	1	1	2	2	2	34
27	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	1	1	2	1	2	1	1	1	31
28	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	2	2	1	2	2	32
29	1	1	2	1	1	2	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	29
30	2	2	2	2	2	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	34

THE SUGGESTED PROGRAMME

A Suggested Programme for Developing 4th Year Primary Pupils' Performance in Mathematical Word-problems in Kuwait

Meshal Bader Almansouri

Brunel University

Teacher's Guide

Introduction

This is a suggested programme which is intended to develop 4th year primary pupils' performance in mathematical word-problems in Kuwait. Despite its importance in teaching and learning mathematics, teaching how to solve mathematical word-problems is not explicitly included in our pupils' textbooks, either pre or during the primary stage. This negligence is partly due to the misconception that word-problems are difficult for pupils to solve in all levels of study especially during the first four years of primary school. This misconception has affected the design and teaching of the mathematical curriculum in our schools in Kuwait as we find that most mathematics books delay teaching word-problems to the end of the 3rd or the 4th year in primary school. Therefore, it is hoped that this programme will help develop 4th year primary pupils' performance in mathematical word-problems.

General aims of the programme

(6) Developing 4th year primary pupils' performance in reading mathematical word-problems.

(7) Developing 4th year primary pupils' performance in understanding word-problems.

(8) Developing 4th year primary pupils' performance in converting digits in word-problems from verbal into symbolic forms.

(9) Developing 4th year primary pupils' performance in determining the appropriate mathematical operation in word-problems.

(10) Developing 4th year primary pupils' performance in arriving at the correct solution to word-problems.

Presentation Method

1. Explicit Instruction
2. Discussion

Activities

1. Note-taking
2. Role-play
3. Individual work
4. Group work
5. Whole-class work

Teaching Aids

1. Data show
2. Books
3. The board
4. Colour markers
5. Slides
6. Big cards

Evaluation Tools

1. Work sheets and Written tests

Lesson One

Reading Word-problems

General Aim

By the end of this lesson pupils are expected to be able to:

1. Read word-problems

Behavioural Objectives

By the end of this lesson pupils are expected to be able to:

1. Read alphabetical letters correctly.
2. Form different words from given letters.
3. Supply missing letters to form correct words.
4. Read a variety of words and expressions used in word-problems.

Teaching Aids

Flash cards having words of addition, subtraction, multiplication and subdivision - Other flashcards having the most commonly used words and expressions in word-problems - In addition to the board, markers, data show and slides.

Warming-Up

1. Write some alphabetical letters on the board, for example: A – B – K – R – B – Q – S – G – M –A
2. Nominate some able pupils and invite them to come out in front of their colleagues.
3. Ask them, one at a time, to read aloud these letter giving continuous encouragement and corrective feedback.

Presentation & Practice

Activity One

1. Tell your pupils that in order to better understand and correctly solve a given word-problem, they must be able to read this problem well.
2. Tell them that, in this lesson, they are going to learn with you how to read word-problems well.
3. Do the following exercise before your students asking them to pay attention to you:

Arrange the following letters to form meaningful words: **e-n-p. / o-k-o-b / d-l-n-r-a / b-y-u / l-i-o-k**

4. Help them with these answers; **pen / book / dinar / buy / kilo**.

Activity Two

Group work

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Ask them to work together in each group and to arrange the following letters to form meaningful words:

S-p-r-e-u-m-r-a-k-t-e / t-s-u-n-d-e-t / n-b-n-a-s-a-a-s

/ s-i-l-c-p-e-n

3. Then, ask the spokesman in each group to tell the whole class his groups' arrangements of the given words.
4. Help them with these answers; **supermarket / student / bananas / pencils**.

Activity Three

Individual Work

1. Ask the pupils to match the letters from column **(A)** with the appropriate choice from **(B)** to form correct words:

(A)	(B)
1- Super	**- d**
2-Differ	**- tracts**
3- divi	**- ence**
4- Sub	**- market**
5- Ad	**- de**
6- We	**- nt**
7- Sa	**- ra**
8- scho	**- ol**

2. When finished, select some of them to tell you, individually, before the whole class, how they finished this exercise.
3. Give continuous encouragement and corrective feedback.

Activity Four

Whole-Class Work

1. Write the following completion exercise on the board.

1. Studen__
2. Ad__
3. Subtra__ __
4. Divi__ __
5. Multip__ __
6. Scho__ __
7. Sup__ __ mark__t

2. Ask the pupils to complete the words by supplying the missing letters to form correct words.

3. When finished, ask some of them to read aloud the completed words.
4. Give continuous encouragement and corrective feedback.

Activity Five

Whole-Class Work

1. Use flash cards to present to the pupils the following words and expressions related to different mathematical operations;

Subtract	**Divide**	**what is the total?**	**multiply**	**what is added up?**

what is cut down?	**what is the increase?**	**What is the difference?**	**Add**	**Cut down**

2. Tell them that the cards present words and expressions indicating addition, subtraction, multiplication and division.
3. Tell them that these words and expressions are commonly found in word-problems.
4. Read aloud these cards, one at a time, before the pupils asking them to pay attention to you.
5. After that, show these cards, one at a time, and ask the pupils to read them.
6. Give continuous encouragement and corrective feedback.

Activity Six

Whole-Class Work

1. Repeat the same previous activity with the following words using flash cards.
2. Tell them that these words might be found in mathematical word-problems.

Library - Shelves - Pen - Book - Chair - table - Your brother - Your Father – School – Supermarket – Pupils – Class – Market – Two days.

Evaluation

1. Prepare worksheets containing the following exercises;
2. Ask the pupils to answer these exercises.

(a) Match the letters from column (A) with the appropriate choice from (B) to form correct words:	
1- div	- tract
2- sub	- ide
3- to	- iply
4- mult	- tal
5- ad	- nar
6- di	- d

(b) Form suitable words from the following letters:
Soyt ------------------- Fram ------------------- Godos ------------------ sicybces ----------------- oilsk ------------------

(c) Complete the missing letters to form correct words:
- Sch__ __ __
- Sup__ __ mark
- Ad__
- Comple__ __

3. When finished, correct their answers and give them encouragement and feedback.

Lesson Two

Reading Word-problems

General Aim

By the end of this lesson pupils are expected to be able to:

1. Read word-problems.

Behavioural Objectives

By the end of this lesson pupils are expected to be able to:

1. Read various words used in word-problems.
2. Match words with what suits them from the operations symbols.
3. Read easy and simple problems.
4. Read word problems.

Teaching Aids

Flash cards containing words of addition, subtraction, multiplication and subdivision. Other flashcards containing words commonly used in word-problems . The board - Markers - Data Show - Slides.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Write a few words on the board learned by the pupils during the previous lesson. These might be;

Pens - Pencils - Sell - buy - Kuwaiti Dinar – Divide – Add - cut down – increase……….

(ii) Nominate some pupils and ask them to come out in front of their colleagues.

(iii) Ask them, one at a time, to read aloud the words you have written on the board.

(iv) Encourage those who best learned the words and give corrective feedback to other pupils.

Presentation & Practice

Activity One

1. Tell your pupils that in order to understand and solve a given word-problem, they must be able to read this problem well.
2. Tell them that, in this lesson, they are also going to learn with you how to read words and expressions indicating different mathematical operations in long and complex problems.
3. Ask them to complete this exercise with you;

Match the letters from column (A) with the appropriate choice from (B) to form correct words:	
(A)	**(B)**
1- Super	**- d**
2-Differ	**- tracts**
3- divi	**- ence**
4- Sub	**- market**
5- Ad	**- de**
6- We	**- nt**
7- Sa	**- ra**
8- scho	**- ol**
9- What's the	**- difference**

4. When finished, select some of them to read the completed words and expressions to the whole class.
5. Give continuous encouragement and corrective feedback.

Activity Two

Group work

1. Ask the pupils to make equal groups of five.
2. Use flash cards showing the following words and expressions.

What's the rest?	**Multiply**	**Divide**	**What is cut down?**	**What is the difference?**	
Bookshop	**Sweets**	**Chocolate**	**Fruit**	**Vegetables**	
School	**Super market**	**Chair**	**Pupils**	**Table**	**Father**

3. Read aloud for your pupils the words and expressions in these cards.
4. After that, ask the pupils in each group to read aloud the words and expressions on these cards. Take a group at a time.
5. When all groups have finished reading, praise the best group that read fluently and give corrective feedback to the other groups.

Activity Three

Whole-Class Work

1. Tell your pupils that, since they have mastered reading separate words and expressions commonly used in mathematical word-problems, they are going to read longer mathematical sentences.
2. Use the data show to present the following sentences to your pupils;
   - **A) Ahmad went to school.**
   - **B) Mohamed bought a car and a TV.**
   - **C) Khalid read two stories on the first day.**
   - **D) And read three stories on the second day.**
   - **E) Waleed went with his father to the supermarket and bought some sweets.**

3. Read aloud these sentences to your pupils asking them to pay attention to you.

4. After that, select some able pupils, one at a time, to read aloud these sentences.
5. Repeat this reading task some more times with other pupils.

Activity Four

Whole-Class Work

1. Tell your pupils that, in this activity they are going to read longer sentences and mathematical word-problems to get accustomed to reading such problems.
2. Use the data show to present the following sentences to your pupils;
   - **(a)** There are many classes and play grounds in my school; it is one of the best schools, so I have to keep it clean.
   - **(b)** Julie collected her books in her bag and went to school. The first lesson was Mathematics, her favourite subject.
   - **(c)** Ahmad gave his friends some balloons to celebrate his birthday, as he was very happy with this occasion. They blew out the candles and ate the cakes. His friends were so happy and gave him some lovely gifts. The party cost him about 120 Kuwaiti Dinars.
   - **(d)** Wafaa went to the market with her mother to buy some goods they needed at home. They bought some food, including cheese, cream, bread, nuts, meat and chicken. The items cost about 50 Kuwaiti Dinars.

3. Read aloud these sentences to your pupils asking them to pay attention to you.
4. After that, select some able pupils, one at a time, to read aloud these sentences.
5. Repeat this reading task some more times with other pupils until you feel that they can read fluently.

6. Praise and encourage the pupils who read well and give corrective feedback to poor readers.

Evaluation

1. Prepare a work sheet containing longer mathematical sentences.
2. Distribute these work sheets among your pupils.
3. Ask the pupils, one at a time, to come out in front of their colleagues and ask each pupil to read aloud the sentence on his work sheet.
4. When each finishes reading his work sheet, give him a mark on his reading in front of his colleagues.
5. The work sheet could be similar to the one which follows;

Yussef went to the market with his father to buy some stationery for school. He bought some notebooks, pens and glue. He paid about 14 Kuwaiti Dinar.

I got up early and I had my breakfast, but my brother Jassem woke up late because he overslept. I went to school by bus while my brother missed it, so my father drove him to school. He arrived at school late.

Mona read a lovely story about co-operation and love among friends. Her father bought it for her.

Lesson Three

Understanding Word-problems

General Aim

By the end of this lesson, pupils are expected to be able to:

1. Understand word-problems

Behavioural Objectives

By the end of this lesson, pupils are expected to be able to:

1. Read various mathematical phrases correctly.
2. Read different words used in word-problems.
3. Recognise the available data included in a word-problem.
4. Answer questions related to the problems.
5. Fully understand word-problems.

Teaching Aids

Big cards – white board and colour marker – data show – slides - A model of a small grocery shop.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity

(i) Write a few sentences on the board containing some words learned by the pupils during the previous lesson. Sentences might be something like;

- Ahmad went to the market with his father and bought a story and a pen.
- Mohamed distributed the balloons he had to his friends equally.
- Khalid bought 5 apples and ate 3 of them.

- There are many classes, pupils and teachers at my school.
- Noura bought a postal stamp collection because she likes collecting stamps.

(ii) Nominate some pupils and ask them to come out in front of their colleagues.

(iii) Ask them, one at a time, to read aloud the sentences you have written on the board.

(iv) Encourage those who learned the sentences,best and give corrective feedback to other pupils.

<u>Presentation & Practice</u>

<u>Activity One</u>

1. Tell your pupils that in order to solve a given word-problem, they must be able to understand this problem well.
2. Tell them that, in this lesson, they are going to learn with you how to understand word-problems and recognise the available data included in these problems.
3. Use data show to present the following word-problem to the pupils;

Jassem went with his father to the supermarket. He bought a box of candy for two Dinars and a kilo of oranges for one Dinar.

4. Use a small model of a grocery shop containing some items at the prices mentioned in the problem.
5. Raise the following questions based on the word-problem presented to the pupils;

- Where did Jassem go?
- Who did Jassem go with?
- What did Jassem buy?

6. Tell the pupils that to better understand a word-problem, one should raise some questions that test understanding of a given problem like those you have raised.
7. After that, answer these questions for the pupils asking them to pay attention to you.
8. Help them with the following answers;
   - Jassem went to the supermarket.
   - He went with his father.
   - He bought a box of candy.

Activity Two

Group work

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Ask them to work together in each group and to read the following word-problem:

Ahmad bought a washing machine and a fridge, since his old washing machine has become very old and doesn't work well anymore, and he doesn't have a fridge, so he decided to buy one.

3. After that, ask them to answer these questions that test understanding of the given problem;
   - **What did Ahmad buy?**
   - **Why did Ahmad buy a washing machine?**
   - **Why did he buy a fridge?**
4. When finished, ask the spokesman in each group to tell the whole class his groups' answers to these questions.
5. Give continuous encouragement and corrective feedback.

<u>Activity Three</u>

<u>Individual Work</u>

1. Use the data show to present the following problem to your pupils;

   Mohamed had some sweets and chocolates. He gave his brother Abdulla some chocolate and his younger brother Ahmad some sweets he had bought from the supermarket.

2. Ask the pupils to work individually and to answer the following questions on this word-problem;
   - What did Mohamed have?
   - Who are Mohamed's brothers?
   - What did Mohamed distribute to his brothers?
3. When finished, select some of them to tell you, individually, before the whole class the answers to these questions.

4. Give continuous encouragement and corrective feedback.
5. Help them with the following answers;
   - Mohamed had some sweets and chocolates.
   - Mohamed's brothers are Abdulla and Ahmed.
   - He distributed some chocolates and sweets to his brothers.

Activity Four

Whole-Class Work

1. Present the following word-problem using the board;

Ahmad is a stamp collector – he has collected a lot of stamps, while Jassem loves football and likes watching football matches on TV. Ahmad and Jassem are friends, however, they don't share hobbies.

2. Read the problem to your pupils asking them to pay attention to you.
3. Then, ask them to read it silently and to think of the following questions;
   - **What is Ahmad's hobby?**
   - **What does Jassem like?**
   - **Do Ahmad and Jassem share the same hobbies?**
4. One at a time, ask them to give the answers to these questions.
5. You can ask one pupil to read the question and another to give the answer.
6. Give continuous encouragement and corrective feedback.

Evaluation

1. Prepare worksheets containing exercises on understanding word-problems.
2. Ask the pupils to answer these exercises.
3. These sheets could be like the following;

(a) Suad went to the bookshop and bought a bag for 25 Kuwaiti Dinars and a box of colours for 14 Dinars.

Answer these questions:

i. Where did Suad go? --

i. What did she buy? --

i. How much is the bag? --

. How much is the box of colours? --- ---------------

(b) Susan went with her family to the zoo. She watched a lot of animals and birds, played, took photographs of the birds and fed domestic animals, because she likes them while her brother Ali fed and played with the deer.

Answer these questions

i. Where did Susan go? --

i. Who did Susan go with? ---

i. What did Susan watch at the zoo?---------------------------------

. What's her brother's name?--

. What did Susan do at the zoo?--------------------------------------

4. When finished, correct their answers and give them encouragement and feedback.

Lesson Four

Understanding Word-problems

General Aim

By the end of this lesson pupils are expected to be able to:

1. Understand word-problems.

Behavioural Objectives

By the end of this lesson pupils are expected to be able to:

1. Read various mathematical phrases correctly.
2. Recognise the available data [data given in a word-problem].
3. Answer questions related to the problems
4. Fully understand word-problems.

Teaching Aids

White board - Colour Markers - Data show – Slides - An explanatory Chart - Big cards containing some mathematical sentences.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Emphasizing the importance of reading in understanding and solving word-problems, use big cards and write the following sentences on them;

- Mona went with her mother to the scientific museum where they found ancient monuments and strange antiquities.
- Noof travelled to Europe in the summer holiday. She was impressed by the fantastic sightseeing.
- Jassem distributed the sweets and chocolate he had bought at the supermarket equally among his brothers.

- I went with my family to Fun City. The games were so lovely. We enjoyed it a lot and went back home late.

(ii) Nominate some pupils and ask them to come out in front of their colleagues.

(iii) Ask them, one at a time, to read aloud the sentences you have written on the cards.

(iv) Encourage those who read the sentences best, and give corrective feedback to poor readers.

<u>Presentation & Practice</u>

<u>Activity One</u>

1. Tell your pupils that in order to solve a given word-problem, they must be able to understand this problem well.
2. Tell them that, in this lesson, they are going to learn with you how to best understand word-problems and recognise the available data included in these problems.
3. Write the following word-problem on the board;

Jassem bought 12 pens for four Kuwaiti dinars a pen.

4. Ask the pupils to read this problem.
5. Then, raise the following questions that test understanding of the mentioned problem;
   - What did Jassem buy?
   - How many items did he buy?
   - How much is each pen?
6. Tell the pupils that to better understand a word-problem, one should raise some questions that test understanding of a given problem like those you have raised.

7. After that, answer these questions for the pupils asking them to pay attention to you.
8. Help them with the following answers;
   - Jassem bought some pens.
   - He bought 12 items.
   - Each pen is four Kuwaiti dinars.

<u>Activity Two</u>

<u>Group work</u>

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Ask them to work together in each group and to read the following word-problem:

Khalil bought many sweets. He gave his brother Jassem 24 pieces who ate 7 of them.

3. After that, ask them to answer these questions that test understanding of the given problem;
   - What did Kahlil buy?
   - Who is Khalil's brother?
   - How many sweets did Khalil give to his brother?
4. When finished, ask the spokesman in each group to tell the whole class his groups' answers to these questions.
5. Give continuous encouragement and corrective feedback.

<u>Activity Three</u>

<u>Individual Work</u>

1. Use the data show to present the following problem to your pupils;

Huda distributed 35 pens among her sisters and brother. She gave Hind the red pens, Mona the yellow pens and Jassem the blue ones.

2. Ask the pupils to work individually and to answer the following questions on this word-problem;
    - What did Huda distribute?
    - What are her sisters' names?
    - To whom did she give the blue pens?
    - To whom did she give the red pens?
3. When finished, select some of them to tell you, individually, before the whole class the answers to these questions.
4. Give continuous encouragement and corrective feedback.
5. Help them with the following answers;

<u>Activity Four</u>

<u>Whole-Class Work</u>

1. Present the following word-problem using the data show;

A father returned from France and distributed gifts among his children. He gave Bader the eldest son a gift that equals 10 Kuwaiti Dinars, he gave Yussef the youngest another one that equals 5 Kuwaiti Dinars, and he gave a third one to the youngest daughter Raghad that equals 4 Kuwaiti Dinars.

2. Read the problem to your pupils asking them to pay attention to you.
3. Then, ask them to read it silently and to think and then come up with some questions that test understanding of this problem.
4. One at a time, ask them to voice their suggested questions.
5. Give continuous encouragement and corrective feedback.

6. Help them with the following questions;
   - Where did the father come back from?
   - What is the eldest son's name and how much was his gift?
   - What is the youngest daughter's name and how much was her gift?

Evaluation

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(a) Read the following and answer the questions below;

Huda distributed 35 pens among her five friends.

What did Huda distribute? ---

How many pens did she distribute?-----------------------------------

How many friends does Huda have?-----------------------------------

(b) Read the following and answer the questions below;

Wafaa bought a lot of chocolates and sweets from the supermarket. She gave her brother Hamad 15 chocolates and sweets. He ate 9 of them.

- **Give three questions that test understanding of this problem:**

(1) --

(2) ---

(3) --

2. When finished, correct their answers and give them encouragement and feedback.

Lesson Five

Converting Digits from Verbal into Symbolic Forms

General Aim

By the end of the lesson pupils are expected to be able to:

1. Convert digits from verbal into symbolic forms

Behavioural Objectives

By the end of the lesson pupils are expected to be able to:

1. Read problems well.
2. Recognise the available data [data given in a word-problem].
3. Understand word-problems.
4. Realize what is required in a word-problem.
5. Convert digits from verbal into symbolic forms.

Teaching Aids

Cards showing digits in symbolic and verbal forms - Big explanatory chart - Data show and slides – Markers - The board – Kuwaiti coins and banknotes.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Revising what pupils have learned during the previous lesson, write the following word-problem on the board;

Khalid bought 5 pens, each one for 3 Kuwaiti Dinars. He also bought 3 rulers, each one for 2 Kuwaiti Dinars.

(ii) Read the problem aloud to your pupils asking them to pay attention to you.

(iii) Nominate some pupils and invite them to come out in front of their colleagues.

(iv) Divide them into two equal groups.

(v) Ask one group of them to come up with some questions that test understanding of this word-problem, and ask the other group to answer these questions.

(vi) Help them with the following questions;

- What did Khalid buy?
- How many pens did he buy?
- How many rulers did he buy?
- What is the price of each pen?
- What is the price of each ruler?

Presentation & Practice

Activity One

1. Tell your pupils that in order to solve a given word-problem, they must be able to convert digits from verbal into symbolic forms.
2. Tell them that, in this lesson, they are going to learn with you how to convert digits included in a given word-problem from verbal into symbolic forms.
3. Show them some flash cards demonstrating digits written in verbal form on one side and their equivalent symbols on the other side.
4. Cards could include the following:

Side One	Side Two
Five hundred and sixty	**560**

Side One	Side Two
Six hundred and seventy	**670**

Side One	Side Two
One million seven hundred and forty	**1000740**

5. Show them one side of the card and read it with them, then show them the other side of the card telling them that the first side contains the digits in a verbal form, whereas the second side contains the symbolic forms of these digits.
6. Ask them to read aloud the verbal digits and their equivalent symbolic forms while you are showing them.

Activity Two

Group work

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Give them a group of small cards, like those which you have used in the previous step, but this time the cards should be one-sided.
3. Shuffle these cards well before giving them to the pupils.

4. Ask them to work together in each group and to find similar cards (cards including digits in verbal forms with the cards including the same digits in symbolic forms).
5. When finished, ask the spokesman in each group to show their pairs of matched cards.
6. Praise the group that finishes first.

Activity Three

Individual Work

1. Write the following exercise on a big chart displayed to the pupils;

(a) Six million three hundred thousand and one.
6300001 – 630001 - 63001
(b) Four thousand and three.
403 - 4003- 3003
(c) Four million and fifty.
400050 - 4000050 - 400050

2. Ask them to come out in front of their colleagues and to put a circle around the symbols that indicate each verbal number displayed.
3. Give continuous encouragement and corrective feedback.

Activity Four

Whole-Class Work

1. Ask the pupils to complete the following exercise;

Convert the following numbers from verbal to symbolic:

(a) Three hundred and ten.------------------------------------

(b) Two million and sixty. ------------------------------------

(c) Seven thousand and fifty. ----------------------------------

(d) Four million and eighty. ---------------------------------

(e) Four thousand and fifty. ---------------------------------

(f) Three million four hundred.-------------------------

(g) Five hundred and sixty three.-----------------------------

2. Help them with the following, giving corrective feedback;

(a) Three hundred and ten.-------------310------------

(b) Two million and sixty. -----------------2000060-------------------

(c) Seven thousand and fifty. ----------------7050------------------

(d) Four million and eighty. ------------------4000080---------------

(e) Four thousand and fifty. ---------------4050------------------

(f) Three million four hundred.---------3000400---------------

(g) Five hundred and sixty three.--------------563---------------

Evaluation

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(I) Convert the following numbers from verbal to symbolic:
(a) Four hundred and six.---------------------------------- **(b)** Three million and twenty. ---------------------------------- **(c)** Eleven thousand and forty. --------------------------------- **(d)** Three million and eighty five. -------------------------------- **(e)** Nine thousand and thirty. -------------------------------- **(f)** Five million seven hundred.------------------------

(II) Convert the following numbers from symbolic to verbal:
(a) 4051--------------------------------- **(b)** 7005000 ---------------------------------- **(c)** 34200043 -------------------------------- **(d)** 1003560 ------------------------------- **(e)** 543 -------------------------------

2. When finished, correct their answers and give them encouragement and corrective feedback.

Lesson Six

Converting Digits from Verbal into Symbolic Forms

General Aim

By the end of the lesson pupils are expected to be able to:

1. Convert digits in word-problems from verbal into symbolic forms.

Behavioural Objectives

By the end of the lesson pupils are expected to be able to:

1. Read problems well.
2. Recognise the available data [data given in a word-problem].
3. Understand word-problems.
4. Realize what is required in a word-problem.
5. Convert digits in word-problems from verbal into symbolic forms.

Teaching Aids

The board **–** colour markers – slides – work sheets - data show - big cards holding digits symbols and verbal names – a model of a bookshop.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Revising what pupils have learned during the previous lesson, write the following exercise on the board;

Convert the following numbers from verbal to symbolic:
(a) Four hundred and nine.-----------------------------------
(b) Five million and twenty. -----------------------------------
(c) Eight thousand and thirty. ----------------------------------

(ii) Invite some clever pupils to come out in front of their colleagues and ask them, one at a time, to complete this exercise.

(iii) Give continuous encouragement and corrective feedback.

Presentation & Practice

Activity One

1. Tell your pupils that, as they know, in order to solve a given word-problem, they must be able to convert digits from verbal into symbolic forms.

2. Tell them that, in this lesson, they are also going to learn with you how to convert digits in word-problems from verbal into symbolic forms.

3. Present the following mathematical word-problem to them using the blackboard.

Sara bought twenty five pens, each pen is for seven KD. How much did Sara pay? What did Sara buy? What is the total number of pens Sara bought? What is the price of one pen?

4. Tell them that in order to solve this problem, we need to read, understand and then convert digits from verbal to symbolic.

5. Tell them that during the previous lessons, they learned how to read and raise questions on a given word-problem that tested understanding.
6. Tell them that, in this lesson, they are going to convert digits in a word-problem from verbal to symbolic.
7. Convert the verbal numbers in the problem into symbolic forms asking them to pay attention to you.

Activity Two

Group work;

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Write the following mathematical word-problem on some cards;

"Mohamed sold some goods for three hundred and fifty KD on the first day. On the second day, he sold some other items for six hundred and sixty three KD, while his father sold his company for two million and fourteen thousand KD."

- **How much did Mohamed sell on the first day?**
- **How much did he sell on the second day?**
- **For how much did Mohamed's father sell his company?**

3. Distribute the cards among the different groups.
4. Ask the pupils in each group to work together and to convert the verbal numbers in the problem into symbolic forms.
5. When finished, ask the spokesman in each group to read the answers of his group.
6. Praise the groups that gave the correct answers and finished first.

Activity Three

Whole-Class Work

1. Write the following word-problem on the board.

"A father gave his eldest son one million five hundred thousand and forty KD to buy a house for himself and he gave his middle younger son one hundred and forty thousand and fifteen KD to buy a chicken farm, while the youngest son was given sixty nine thousand four hundred KD to buy a car."

2. Ask them to answer the following questions about the mathematical word-problem written on the board.
3. Ask them to give the numbers in their answers in both verbal and symbolic forms.

Question	**Verbal Forms**	**Symbolic Forms**
(a) How much did the father give to his eldest son?		
(b) How much did the father give to his youngest son?		
(c) How much did the father give to his middle son?		

4. Give continuous encouragement and corrective feedback.

<u>Activity Four</u>

<u>Individual Work</u>

(1) Use the data show to present the following word-problem to your students.

"**Dana and Sara went to the market to buy some jewels.** **Sara called at the first jewellers' and bought a diamond set for five hundred thousand and forty two KD, while Dana bought a gold watch at the same shop for twenty four thousand two hundred KD."**

(2) Ask them to work individually and to read the problem silently.

(3) After that, distribute copies of the following sheet among your pupils asking them to complete them.

Question	Verbal forms	Symbolic Forms
For how much did Sara buy the diamond set?	---------------	------------
For how much did Dana buy the gold watch?	---------------	--------------

(4) When finished, ask them to read aloud their answers, one at a time.

Encourage those individuals who gave correct solutions and give corrective feedback to others.

Evaluation

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(I) Khalifa sold his large house for four million and fifty thousand and bought another smaller one for one million and fifty five Kuwaiti Dinars.

Questions	**Verbal Forms**	**Symbolic Forms**
• **For how much did Khalifa sell his large house?**		
• **For how much did he buy his smaller house?**		

(II) Mohamed bought some goods for two millions and three thousand on the first day, while he bought other items on the next day for one million and twenty thousand.

Questions	**Verbal Forms**	**Symbolic Forms**
• **For how much did Mohamed buy the goods on the first day?**		
• **For how much did Mohamed buy the goods on the next day?**		

2. When finished, correct their answers and give them encouragement and corrective feedback.

Lesson Seven

The Appropriate Choice of Mathematical Operation

General Aim

By the end of the lesson pupils are expected to be able to:

1. Determine the appropriate mathematical operation for word-problems.

Behavioural Objectives

By the end of the lesson pupils are expected to be able to:

1. Read problems including different mathematical operations, for example, addition, subtraction, multiplication, and division.
2. Understand word-problems.
3. Convert numbers from verbal to symbolic forms.
4. Determine the appropriate mathematical operation needed in solving a given word-problem.

Teaching Aids

Colour markers - the board – books - big cards- data show - slides – work sheets.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Revising what pupils have learned during the previous lessons, write the following word-problem on the board;

Jassem went to the supermarket with his father to buy some chocolate and sweets. He paid four hundred and sixty five Fils.

(ii) Read the problem aloud to your pupils asking them to pay attention to you.

(iii) Nominate some pupils and invite them to come out in front of their colleagues.

(iv) Divide them into two equal groups.

(v) Ask one group to come up with some questions that test understanding of this word-problem, and ask the other group to answer these suggested questions.

(vi) Help them with the following questions;

- Where did Jassem go?
- Why did he go there?
- How much did he pay?

(vii) After that, ask both groups to convert the digits included in the problem from verbal to symbolic forms.

(viii) Give continuous encouragement and corrective feedback.

<u>Presentation & Practice</u>

<u>Activity One</u>

1. Tell your pupils that in order to solve a word-problem, in addition to reading well, understanding, and converting digits from verbal to symbolic forms, they must be able to determine the appropriate mathematical operation needed for solving that word-problem.

2. Tell them that, in this lesson, they are going to learn with you how to choose the appropriate mathematical operation needed for solving a given word-problem.

3. Present the following word-problem to the pupils using the data show;

What is the total of six hundred and seventy five, plus three hundred and twenty five.

4. Ask them to read it carefully.

5. Tell them that, in order to solve such a problem, we need to determine the appropriate mathematical operation needed, whether it is addition, subtraction, multiplication or division.
6. Tell them that there are certain words and expressions in a given word-problem that denote the type of operation needed.
7. Explain the following examples to the pupils;

The word or the expression	**The indicated operation**	**The operation symbol**
The total of	addition	+
Add	addition	+
Cut down	subtraction	-
Divide	division	÷
The increase in	subtraction	-
What is the difference between X and Z?	subtraction	-
The difference between X and Z	subtraction	-
Multiply	multiplication	x

8. After that, tell them that based on this table the appropriate mathematical operation for the above-mentioned problem is **addition**.
9. Finally, tell them that determining the appropriate mathematical operation is crucial to solving a given problem.

Activity Two

Group work

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Present the following problem using the data show;

Cut down one hundred and fifty nine from seven hundred.

3. Ask them to work together in each group and: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operation needed for solving this problem.
4. When finished, ask the spokesman in each group to say aloud the answers to the whole class.
5. Praise the group that finished first.

Activity Three

Individual Work

1. Present the following problem using the data show;

Add one hundred thousand five hundred and forty to twenty thousand one hundred.

2. Ask the pupils to work individually and: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operation needed for solving this problem.
3. Help them with the following;
    - **One hundred thousand five hundred and forty** = 100540
    - **Twenty thousand one hundred** = 20100
    - **The appropriate mathematical operation needed is "addition"**
4. Give continuous encouragement and corrective feedback.

Activity Four

Whole-Class Work

1. Present the following problems using the data show;

Divide one thousand two hundred and forty four by twenty four.

Multiply one hundred and fifty five by four hundred and thirteen.

Jassem is one hundred and forty five cm tall while Ahmad is one hundred and thirty three cm. tall. What is the increase in Jassem's height compared with that of Ahmad?

2. Ask the pupils: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operations needed for solving these problems.

3. Help them with the following for the first problem;

- **One thousand two hundred and forty four** = 1244
- **Twenty four** = 24
- **The appropriate mathematical operation is "division"**

4. Help them with the following for the third problem;

- **One hundred and forty five cm** = 145cm
- **One hundred and thirty three cm** = 133cm
- **Since the expression "the increase in" refers to subtraction, the appropriate mathematical operation is "subtraction"**

5. When finished, select some of them, one at a time, to speak aloud the correct answers.

6. Give continuous encouragement and corrective feedback.

<u>Evaluation</u>

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(I) Read this problem and determine the appropriate mathematical operation:
Add four hundred and sixty five to one thousand six hundred and seventy. **The appropriate mathematical operation is ----------------------**

(II) Read this problem and determine the appropriate mathematical operation:
Divide one thousand two hundred by four. **The appropriate mathematical operation is ----------------------**

(III) Read this problem and determine the appropriate mathematical operation:
Wafaa is 147cm tall and Hoda is 166 cm tall. **What is the increase in Hoda's height compared with that of Wafaa?** **The appropriate mathematical operation is ----------------------**

(IV) Read this problem and determine the appropriate mathematical

operation:

Multiply two hundred and fifty six by three hundred and sixteen.

The appropriate mathematical operation is………………….

2. When finished, correct their answers and give them encouragement and corrective feedback.

Lesson Eight

The Appropriate Choice of Mathematical Operation

General Aim

By the end of the lesson pupils are expected to be able to:

1. Determine the appropriate mathematical operation in word-problems.

Behavioural Objectives

By the end of the lesson pupils are expected to be able to:

1. Read problems including different mathematical operations, for example, addition, subtraction, multiplication, and division.
2. Understand word-problems.
3. Convert numbers from verbal to symbolic forms.
4. Determine the appropriate mathematical operation needed to solve a given word-problem.

Teaching Aids

Colour markers – books – the board – slides - big cards demonstrating some word-problems - data show – work sheets.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Revising what pupils have learned during the previous lessons, write the following word-problem on the board;

Sara went to the jeweller to buy some jewels on the occasion of her marriage; she bought a ring for four hundred and thirty Kuwaiti Dinars. Also she bought a necklace for five thousand four hundred and twenty Kuwaiti Dinars.

(ii) Read the problem aloud to your pupils asking them to pay attention to you.

(iii) Nominate some pupils and invite them to come out in front of their colleagues.

(iv) Divide them into two equal groups.

(v) Ask one group to come up with some questions that test understanding of this word-problem, and ask the other group to answer these suggested questions.

(vi) Help them with the following questions;

- Where did Sara go?
- Why did she go there?
- What did she buy?
- How much did she pay?

(vii) After that, ask both groups to convert the digits included in the problem from verbal to symbolic forms and to determine the appropriate mathematical operation for solving this problem.

(viii) Help them with the following;

- Four hundred and thirty Kuwaiti Dinars = 430 Kuwaiti Dinars
- Five thousand four hundred and twenty = 5420 Kuwaiti Dinars
- The appropriate operation is **"addition"**

(ix) Give continuous encouragement and corrective feedback.

Presentation & Practice

Activity One

1. Again, tell your pupils that in order to solve a given word-problem, in addition to reading well, understanding, and converting digits from verbal to symbolic forms, they must be able to determine the appropriate mathematical operation for solving a given word-problem.
2. Tell them that, in this lesson, they are going to learn with you how to determine the appropriate mathematical operation needed to solve a long and complex word-problem.
3. Present the following word-problem to the pupils using the data show;

A post office sold two thousands six hundred and forty stamps on the first day and nine hundred and fifty eight stamps on the second day, "How many stamps did it sell in two days?"

4. Ask them to read it carefully.
5. Tell them again that, in order to solve such a problem, we need to determine the appropriate mathematical operation, whether it is addition, subtraction, multiplication or division.
6. Tell them that there are certain words and expressions in a given word-problem that denote the type of operation needed.
7. Remind them of the key words they studied last time.
8. After that, tell them that the expression "in two days" refers to an operation of "addition"; therefore the appropriate mathematical operation for the above-mentioned problem is **"addition"**.

Activity Two

Group work

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Present the following problem using the data show;

Subtract one hundred thousand and fifty from one hundred thousand four hundreds.

3. Ask them to work together in each group and: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operation for solving this problem.
4. When finished, ask the spokesman in each group to speak aloud the answers to the whole class.
5. Praise the group that finished first.
6. Help them with the following;
   - One hundred thousand and fifty = 100050
   - One hundred thousand four hundred = 100400
   - The appropriate operation is **"subtraction"**

Activity Three

Individual Work

1. Present the following problem using the data show;

Sixty four pens are equally distributed among four boys. How many pens does each one get?

2. Ask the pupils to work individually and: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operation for solving this problem.
3. Help them with the following;

- Sixty four = 64
- Four = 4
- Since the word distribution refers to division, the appropriate mathematical operation is **"division"**

4. Give continuous encouragement and corrective feedback.

<u>Activity Four</u>

<u>Whole-Class Work</u>

1. Present the following problem using the data show;

Our school library has six shelves. On each shelf there are one hundred and twenty five books. How many books are there in the library?

2. Ask the pupils: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operation for solving these problems.
3. Help them with the following;
   - **Six** = 6
   - **One hundred and twenty five** = 125
   - **The appropriate mathematical operation is "multiplication"**
   - **Tell them that** the data we have is a library that has shelves. Each shelf has 125 books.
   - Explain to them that on each shelf there are 125 books. That is to say;

     - The first shelf = 125 books
     - The second shelf = 125 books
     - The third shelf = 125
     - The fourth shelf = 125 books

- The fifth shelf = 125 books
- The sixth shelf = 125 books

- Tell them that this repetition indicates that the appropriate mathematical operation for solving this problem is **"multiplication"**.

4. When finished, select some of them, one at a time, to speak aloud the correct answers.

5. Give continuous encouragement and corrective feedback.

Activity Five

Whole-Class Work

1. Present the following problem using the data show;

> **The number of elementary school teachers in the Gulf countries in 1986 was one hundred and fifty five thousand teachers. U.A.E teachers numbered ten thousand, while in Bahrain, there were eight thousand. In Qatar, there were nine thousand whereas in Kuwait, there were twenty eight thousand. In Oman there were seventeen thousand, whilst Saudi Arabia had the biggest number with one hundred and twelve thousand teachers.**
>
> **1- How many teachers were there in U.A.E. and Oman together?**
>
> **2- How many teachers were there in Kuwait, Bahrain, and Qatar together?**
>
> **3- How many teachers did Kuwait have more than Qatar?**

2. Ask the pupils: first, to convert digits from verbal to symbolic forms; and second, to determine the appropriate mathematical operations needed for solving these problems.

3. Help them with the following;

- **one hundred and fifty five thousand** = 155000

- **ten thousand** = 10000
- **eight thousand =**8000
- **nine thousand** = 9000
- **twenty eight thousand** =28000
- **seventeen thousand** = 17000
- **one hundred and twelve thousand** =112000
- Tell them that the mathematical operation for the first and the second questions is easy to determine through the text of the problem and through understanding the key words that refer to the appropriate mathematical operation; that is, "the number of teachers in the two countries together", as the word together refers to **adding** the two countries together.
- **The appropriate mathematical operation is "addition"**
- Tell them that in the third question, which is about the increase in the number of teachers (did Kuwait have more than Qatar), the word **"more"** refers to **"subtraction"**.

4. When finished, select some of them, one at a time, to speak aloud the correct answers.

5. Give continuous encouragement and corrective feedback.

<u>Evaluation</u>

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(I) Read this problem and determine the appropriate mathematical operation: **The number of grade-three pupils at your school is two hundred and forty three pupils, while there are two hundred and sixty grade-four pupils. What is the difference between the two grades?**

The appropriate mathematical operation is --------------------------------

(II) Read this problem and determine the appropriate mathematical operation:

There are eight shelves at your school library and on each shelf there are one hundred and seventy eight books. How many books are there in the library?

The appropriate mathematical operation is --------------------------------

(III) Forty nine pens are equally distributed among nine boys. How many pens does each one get?

The appropriate mathematical operation is --------------------------------

2. When finished, correct their answers and give them encouragement and corrective feedback.

Lesson Nine

Arriving at the Appropriate Solution to Word-problems

General Aim

By the end of the lesson pupils are expected to be able to:

1. Solve mathematical word-problems.

Behavioural Objectives

By the end of the lesson pupils are expected to be able to:

1. Read problems including different mathematical operations, for example, addition, subtraction, multiplication, and division.
2. Understand word-problems.
3. Convert numbers from verbal to symbolic forms.
4. Determine the appropriate mathematical operation needed to solve a given word-problem.
5. Solve mathematical word-problems.

Teaching Aids

Colour markers – books – the board – slides - big cards demonstrating some word-problems - data show – work sheets.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

- **(i)** Revising what pupils have learned during the previous lessons, write the following word-problem on the board;

Khalid distributed seventy two books over nine shelves equally.

- **(ii)** Read the problem aloud to your pupils asking them to pay attention to you.
- **(iii)** Nominate some pupils and invite them to come out in front of their colleagues.
- **(iv)** Divide them into two equal groups.

(v) Ask one group of them to come up with some questions that test understanding of this word-problem, and ask the other group to answer these suggested questions.

(vi) Help them with the following questions;

- What did Khalid distribute?
- How many shelves are there?
- What does equally mean?

(vii) After that, ask them in both groups to convert the digits included in the problem from verbal to symbolic forms and to determine the appropriate mathematical operation for solving this problem.

(viii) Help them with the following;

- **Seventy two** = 72
- **Nine** = 9
- **The word 'distributed' refers to** division, therefore, the appropriate operation is **"division"**

(ix) Give continuous encouragement and corrective feedback.

<u>Presentation & Practice</u>

<u>Activity One</u>

1. Tell your pupils that in order to solve a given word-problem, we need to read it well, understand it, convert digits included from verbal to symbolic forms, and determine the appropriate mathematical operation needed to solve the problem.
2. Tell them that, in this lesson, they are going to learn with you how to use all the procedures learned in order to find the solution to a given problem.
3. Present the following word-problem to the pupils using the data show;

What is the total of two thousand six hundred and fifty five plus four thousand and eighty?

4. Ask the pupils to read this problem carefully .
5. After that, ask them to test their understanding of this problem by raising some questions about it.
6. Help them with the following;
    - What does the expression "total of" refer to?
    - What does the word "plus" mean?
7. Then, ask them to convert the digits included from verbal to symbolic forms.
8. Help them with the following;
    - **Two thousand six hundred and fifty five** = 2655
    - **Four thousand and eighty** = 4080
9. After that, ask them to determine the appropriate mathematical operation for solving the problem.
10. Help them with the following;
    - The expression "total of" refers to "addition", therefore, the appropriate mathematical operation is **"addition"**.
11. Then, ask them to solve the problem.
12. Help them with the following;
    - 2655 + 4080 = 6745

<u>Activity Two</u>

<u>Group work</u>

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Present the following problem using the data show;

Cut down twenty five thousand from forty four thousand.

3. Ask them to work together in each group and to read this problem carefully , understand it, convert any digits included from verbal to symbolic forms,

determine the appropriate mathematical operation needed to solve the problem, and then to solve it.

4. When finished, ask the spokesman in each group to tell the whole class the correct answer and the way his group reached this solution.

5. Praise the group that finished first.

Activity Three

Individual Work

1. Present the following problem using the data show;

What is the difference between three thousand five hundred and twenty, and one thousand, two hundred and ten?

2. Ask the pupils to work individually and to read this problem carefully, understand it, convert digits included from verbal to symbolic forms, determine the appropriate mathematical operation needed for solving this problem, and to solve it.

3. Help them with the following;

- **Three thousand five hundred and twenty** = 3520
- **One thousand, two hundred and ten** = 1210
- Since the word "difference" refers to subtraction, the appropriate mathematical operation is **"subtraction"**
- The solution is like that: 3520 – 1210 = 2310

4. Give continuous encouragement and corrective feedback.

Activity Four

Whole-Class Work

1. Present the following problem using the data show;

Multiply three hundred and twenty three by two hundred and fifteen.

2. Ask the pupils to read this problem carefully, understand it, convert digits included from verbal to symbolic forms, determine the appropriate mathematical operation needed for solving this problem, and to solve it.

3. Help them with the following;

- **Three hundred and twenty three** = 323
- **Two hundred and fifteen** = 215
- Since the word "multiply" refers to multiplication, the appropriate mathematical operation is **"multiplication"**
- The solution is like that: 323 x 215 = 69445

5. Give continuous encouragement and corrective feedback.

Evaluation

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(I) Read this problem and solve it:
Add fourteen thousand and fifty to twelve thousand and fifteen. -------- **--**

(II) Read this problem and solve it:

Multiplyone hundred and twenty five by one hundred and twelve.   **---**

(III) Read this problem and solve it:
What is the difference between four thousand three hundred and twenty, and two thousand one hundred and five?

2. When finished, correct their answers and give them encouragement and corrective feedback.

Lesson Ten

Arriving at the Appropriate Solution to Word-problems

General Aim

By the end of the lesson pupils are expected to be able to:

1. Solve mathematical word-problems.

Behavioural Objectives

By the end of the lesson pupils are expected to be able to:

1. Read problems including different mathematical operations, for example, addition, subtraction, multiplication, and division.
2. Understand word-problems.
3. Convert numbers from verbal to symbolic forms.
4. Determine the appropriate mathematical operation needed in solving a given word-problem.
5. Solve mathematical word-problems.

Teaching Aids

Colour markers – books – the board – slides - big cards demonstrating some word-problems - data show – work sheets.

FOLLOW-UP AND FEEDBACK

(1) Verbal activity;

(i) Revising what pupils have learned during the previous lesson, write the following word-problem on the board;

Multiply one hundred and sixty by one hundred and twenty.

(ii) Read the problem aloud to your pupils asking them to pay attention to you.

(iii) Nominate some pupils and invite them to come out in front of their colleagues.

(iv) Ask them to work together and to read this problem carefully , understand it, convert digits included from verbal to symbolic forms, determine the appropriate mathematical operation needed for solving this problem, and to solve it.

(v) Help them with the following;

- **One hundred and sixty** = 160
- **One hundred and twenty** 120
- **The word 'multiply' refers to** multiplication; therefore, the appropriate operation is "multiplication".
- **The solution is like that;** 160 X 120 =

(vi) Give continuous encouragement and corrective feedback.

<u>Presentation & Practice</u>

<u>Activity One</u>

1. Again, tell your pupils that in order to solve a given word-problem, we need to read it carefully , understand it, convert digits included from verbal to symbolic forms, and determine the appropriate mathematical operation for solving this problem.
2. Tell them that, in this lesson, they are going to learn with you again how to do all the procedures learned in order to find the solution to a given problem and finally to solve word-problems.
3. Present the following word-problem to the pupils using the data show;

A post office sold seven thousand and thirty four postal stamps on the first day and three thousand and fourteen stamps on the second day. How many stamps are sold on the two days?

4. Ask the pupils to read this problem carefully .

5. After that, ask them to test their understanding of this problem by raising some questions about it.
6. Help them with the following;
    - What does the post office sell?
    - How many stamps sold on the first day?
    - How many stamps sold on the second day?
    - What does the expression "in the two days" refer to?
7. Then, ask them to convert the digits included from verbal to symbolic forms.
8. Help them with the following;
    - **Seven thousand and thirty four** = 7034
    - **Three thousand and fourteen** = 3014
9. After that, ask them to determine the appropriate mathematical operation for solving the problem.
10. Help them with the following;
    - The expression "in the two days" refers to "addition", therefore, the appropriate mathematical operation is **"addition"**.
11. Then, ask them to solve the problem.
12. Help them with the following;

7034 + 3014 = 10048

<u>Activity Two</u>

<u>Group work</u>

1. Ask the pupils to make groups of five. Each group elects a spokesman.
2. Present the following problem using the data show;

Khalid bought a car for nine thousand and fifty Kuwaiti Dinars, while Jassem bought a car for eight thousand seven hundred Kuwaiti Dinars. How much did they pay for both cars together?

3. Ask them to work together in each group and to read this problem carefully , understand it, convert digits included from verbal to symbolic forms, determine the appropriate mathematical operation needed for solving this problem, and to solve it.
4. When finished, ask the spokesman in each group to tell the whole class the correct answer and the way his group reached this solution.
5. Help them with the following;
   - **Khaled bought a car**.
   - **Jassem bought another car.**
   - **Khaled** paid **nine thousand and fifty Kuwaiti Dinars** which converts to = 9050
   - **Jassem** paid **eight thousand seven hundred Kuwaiti Dinars** which converts to = 8700
   - The expression **"both cars together"** refers to "addition", therefore, the appropriate mathematical operation is **"addition"**.
   - Thus, the solution is like that; 9050 + 8700 = 15750 **Kuwaiti Dinars**.
6. Praise the group that finished first.

Activity Three

Whole-Class Work

1. Present the following problems using the data show;

Suad distributed thirty five balloons, equally, among seven girls. How many balloons does each girl get?

Ahmad bought fifteen fridges, each one for forty five Kuwaiti Dinar. How much did Ahmad pay for all these fridges?

2. Ask the pupils to read these problems carefully, understand them, convert digits included from verbal to symbolic forms, determine the appropriate mathematical operations needed for solving these problems, and to solve them.
3. For the first problem, help them with the following;
    - **Thirty five** = 35 balloons
    - **Seven** = 7 girls
    - Since the word **"distributed equally"** refers to division, the appropriate mathematical operation is **"division"**
    - The solution is like that: 35 ÷ 7 = 5 balloons for each girl.
4. Give continuous encouragement and corrective feedback.

Evaluation

1. Prepare the following worksheets, then distribute them to the pupils asking them to answer the questions on these sheets;

(I) Read this problem and solve it:
The number of 4^{th} grade pupils at our school is two hundred and twenty five, whereas the number of 3^{rd} grade pupils is one hundred and thirty four pupils. How many pupils are there in both the 3^{rd} and the 4^{th} grades? **---**

(II) Read this problem and solve it:

Samir bought a car for four thousand Kuwaiti Dinars, while his sister Mona bought some gold for five thousand five hundred. How much are the car and the gold together?

(III) Read this problem and solve it:
It is required to distribute thirty six pens equally among six boys. How many pens will each one get? ---

(IV) Read this problem and solve it:
Noof bought fifteen washing machines for thirty three Kuwaiti Dinars each. How much did Noof pay for all of them? **---**

2. When finished, correct their answers and give them encouragement and corrective feedback.