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Effectiveness of Using KWL Strategy in Teaching Mathematics on the Achievement and Motivation of High School Students in Najran City, KSA

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Abstract*The present study aimed to study the effect of using KWL strategy in the academic achievement and motivation promotion of first secondary graders in mathematics. It also aimed to identify the correlation between achievement and motivation. The sample consisted of (60) participants who were studying at Yarmouk Secondary School in Najran city, Saudi Arabia. They were all divided into two equal groups, control and experimental where each group included (30) students. The experimental group was taught via the use of KWL strategy while the control group was taught through the traditional way. Study materials and tools consisted of an achievement test in the "Quartet Shapes" module at the Analysis, Synthesis, and Evaluation levels, the motivation scale in mathematics, the teacher's guide that was prepared in accordance with KWL strategy, in addition to students' worksheets. Findings showed that there were statistically significant differences between the mean scores of students in the control and experimental groups in the posttest and the motivation for achievement scale in favor of students in the experimental group. Moreover, there was a positive significant correlation between achievement and motivation for achievement in mathematics in favor of students in the experimental group, too.*

Keywords *KWL strategy; academic achievement; motivation; and teaching mathematics.*

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I. Introduction

Mathematics is seen as one of the important academic subjects. It requires a great deal of thinking and the use of higher order thinking skills, i.e. analysis, synthesis, evaluation and reasoning. It is characterized by an educational nature that is clearly represented in its focus on numbers and abstractions. However, learning mathematics will not be effective as desired unless it is based on modern educational methods through which the learner can understand the reality of abstract mathematical concepts and fact and employ them in his daily life (Abu Zina, 2011). Thus, Metacognition strategy is one of the most important strategies for teaching mathematics. The term "metacognition" appeared in the seventies of the twentieth century, through the research of Falavel that tended to focus on the way the learner understands himself as a learner, on one hand and on his ability to plan, follow up and evaluate his learning, on the other hand (Abu Sultan, 2012). The main focus of KWL strategy, which is considered as a metacognition thinking based strategy is on the activation and revitalization of learner's previous knowledge. That is, making previous knowledge the main axis, on which student's newly learnt mathematical knowledge is based and linked to his existing knowledge. KWL strategy enhances teamwork, increases student confidence and gives him the sense that he benefits from what he has learned and acquired. It may play a major role in developing thinking, addressing poor achievement and increasing students' motivation to learn (Qawasmi, 2019). Further, KWL strategy enables students to interact with each other, exchange information they know about the topic, and set learning goals that enhance their understanding process (Al Elayan, 2005; Abu Sultan, 2012).

The importance of using KWL strategy is clearly seen as a teaching strategy because it relies on student's previous knowledge. It helps to activate his previous knowledge and make it a starting point or a focus because it connects the previous knowledge to the new information in the lesson and so it helps him build the meaning. It also helps him to think about the knowledge available to him, and how to gain new knowledge. Therefore, it is consistent with modern educational trends that call for giving the student the opportunity to participate effectively in the teaching context. Furthermore, it has received a lot of attention and follow-up in the educational literature. Research and studies dealing with it has demonstrated its many advantages such as the focus on student positivity, the possibility of being in all academic levels, effectiveness of developing thinking, interest in self-learning, and contribution to increasing and organizing the cognitive structure (Al Elayan, 2005; Attia, 2009).

KWL Strategy

KWLstrategy is defined as "a set of correlated and planned steps implemented by a learner and meanwhile contributes to organizing and summarizing thinking. It consists of three steps that require answering three questions revolving around the learner's knowledge of the subject, what he will learn and what he has learned with the result that ideas are arranged and the learner's efforts are evaluated (Qohar&Sumarmo, 2013) Moreover, it is a constructivist strategy where the learner records all he his background knowledge about the subject matter and then he decides what he needs in light of what is presented by his teacher and at last he records what he has actually learnt. He, then records the most important applications for what is learnt individually or in groups according to the learning context (Gafoor&Kurukkan, 2016). KWL Strategy is also referred to as a "metacognition strategy consisting of a number of systematic ordered steps. The first step is represented by the letter (K) to indicate what the learner actually knows about the subject matter. It is an exploratory step by which students can retain their prior information and use to understand the new topic. The second step is represented by the letter (W) to show what the learner seeks to learn or acquire. Learners, in this step, are guided to determine what they desire to learn, achieve, look for, or discover. The third step begins with the letter (L) to represent what the learner has actually learnt and how much they have benefited from the teaching topic. Its main aim is to correct learners' wrong beliefs and provide them with correct scientific ones through a balance between their prior knowledge with the new one leading to thinking organizing and summary resulting in an increase in the learner's self-confidence and improved achievement (Arram, 2012).

KWL Strategy in teaching mathematics

The importance of using KWL strategy to teach mathematics can be beneficial for both teachers and learners because of the followings (Al Barakati, 2008; Abu Sultan, 2012; & Aseeri, 2016):

1. It is highly effective in developing learners' metacognitive thinking skills.
2. It helps learners think about the lesson, particularly in mathematics.
3. It emphasizes the principles of self-learning and self-reliance in learning.
4. It contributes to increasing and organizing learner's cognitive structure.
5. It is effective in arousing curiosity in thinking.
6. It helps learners plan their ideas.
7. It helps learners determine what they know, want to know and deduce what they have learnt.

Furthermore, by using KWL strategy in teaching mathematics, a set of goals can be achieved like for instance (Al Asbali, 2013 & Al Zaydi, 2015):

1. Activating the student's previous knowledge and making it a starting point or a pillar for linking it to his new knowledge.
2. Engaging students in the active learning process that deals with asking questions and thinking about concepts and queries related to the subject matter.
3. Enhancing students' competence in setting the subject matter objectives, collecting information, presenting outlines for the ideas presented, and writing summaries of them.
4. Orienting the teacher towards a specific educational goal, i.e. what the teacher wants students to learn under the best conditions.

Besides, using KWL strategy in teaching mathematics has a set of merits like (Al Zaydi, 2015; Al Khalifah&Mutawe', 2016):

1. It makes the learner, not the teacher, the center of the educational process.
2. It enables the teacher to enhance the classroom environment and make it effective.
3. It helps the teacher revitalize students' previous knowledge and arouse their curiosity.
4. It enables students to gear their own learning.
5. It emphasizes the learner's activity in creating and extracting meaning.

The learners' roles in KWL strategy

When using KWL strategy, learners have to play these roles (Arram, 2012; Al Asbali, 2013; Qawasmi, 2019). They have to:

1. Read the topics of the chosen lessons and comprehend their ideas.
2. Ask questions that fulfill their cognitive needs based on their previous knowledge.
3. Practice independent thinking in issues and ideas around which the lesson's topic of the lesson revolves.
4. Classify the subject matter ideas into basic and sub-topics.
5. Practice cooperative thinking with group members.
6. Discuss debate and have issues that clarify their validity.
7. Correct their misleading information and facts.

8. Decide what they have actually learnt and try to continue building their cognitive knowledge by generating new questions.

The teacher's roles in KWL strategy

The teacher, on the other hand, has to play these roles (Attiya& Mohammed, 2008; Al Asbali, 2013; Qawasmi, 2019):

1. Plan the objectives of the lesson according to the determined topic that helps in achieving these goals.
2. Reveal students' previous knowledge as a basis for new education.
3. Control class conditions and manage discussion groups.
4. Orient and organize students' knowledge within an effective systematic chart.
5. Debate and generate questions that stimulate students' thinking.
6. Correct students' errors based on their previous knowledge and experience.
7. Evaluate students' performance and the extent to which they achieve desired learning.

In short, we can say that KWL strategy has been effective in promoting academic achievement of learners of varied levels and in different educational stages.

Motivation

Motivation for achievement is defined as "the desire and tendency to face various problems and phenomena, study them. Study, try to overcome obstacles, perform difficult tasks, perform jobs quickly and have a sense of self-esteem (Satohi, 2012). Motivation towards learning mathematics plays a major role in encouraging them and developing their abilities and consequently improving students' achievement in mathematics is important for children, parents, and teachers. Therefore, it is crucial to prepare an encouraging educational environment where challenge, curiosity, control and imagination are developed. In addition, the use of modern, not only traditional, teaching methods by the teacher inside the classroom are very important to improve the students' achievement levels and increase their motivation towards learning mathematics (Saleh, 2017). Because motivation is important for achievement in the learning process, serious efforts emphasize the need to use teaching models and strategies that are concerned with providing a learning environment that helps students to continue learning and achieve goals. Thus, motivation can be the pursuit to achieve a high level of excellence in mathematics through performing tasks and activities and doing related assignments. It can be the excretion of effort and overcoming obstacles that hinder one'sachievement of his goals and thenpromotehis achievement level and helps him achieve a high level of ambition perseverance and competition (Ali, 2012).

Motivation for achievement is one of the important factors related to the goals of school work. It contributes to helping students achieve this motivation by activating their level of performance and achieving the most important aspects of school work motivation. It is an essential component in the individual's pursuit towards achieving himself. Consequently, he will feel that achieving himself can be through what he accomplishes, through the objectives he seeks to fulfill and the better lifestyles and greater levels of his conscious human existence (Abu AlHadeed, 2011). Motivation for high achievement level is the main cause of the depth in thinking processes and intellectual processing. Students do their best to think and achieve because they deal with the problem facing them a personal challenge for them. They think that solving this problem leads to a state of knowledge balance, fulfills their internal needs, and then improves their academic achievement, which is originally a specific level of achievement in school work or in a body of knowledge (Fan &Weiquia, 2009). Moreover, motivation for achievement contributes to maintaining students' high levels of performance without external monitoring. The positive relationship between motivation for achievement, perseverance at work and good performance regardless learners' mental abilities is evident and thus motivation for achievement is a good sign for predicting academic behavior related to success or failure in achievement. (Ali, 2012). Motivation for achievement explains how students understand, build the approaches and methods that enable them to achieve the needs and goals related to mathematics education depending on a set of dynamic interactions that shape their experiences and qualify them to deal with the context (Kim, Schallert, & Kim, 2010).

In light of the above mentioned issues, motivation for achievement is considered as one of the most important Humanitarian motives that must be studied among the variables of the present study. It has an important role in the individual's success achievement. In addition it is known as the pursuit for success and supremacy and the ability to plan for future. It consists of internal and external motives that stimulate behavior. It is not measured directly but inferred from the apparent behavior. Stimulating students' motivation for achievement has an important job during learning mathematics in general. It stimulates students to practice various activities to achieve learning. It mobilizes and conserves students' energy until completing activities and learning occurrence.

Educational literature has pointed to orientation towards work, control place, parental sympathy, fear of failure, retarding anxiety, social acceptance, achievement anxiety, behavior stimulating place, perseverance,

independence, rigidity, self-esteem, success and failure, orientation for future, immersion in work, parental restriction, competition, and environment control as general dimensions of motivation for achievement (AlBitar, 2005). While educational literature pointed to the desire for better performance, self-confidence and self-esteem, orientation towards future, taking responsibility, ambition, enjoying learning math, perseverance, and competition as main dimensions of motivation for achievement in mathematics (Abu AlHadeed, 2011; Mohammed, 2014; Ali, 2012).

In conclusion, it can be said that motivation for achievement generally and motivation for achievement in mathematics can be enhanced by various ways. Using KWL strategy is one of these ways by which teachers can raise and modify their learners' motivation for achievement.

Statement of the problem

Despite the importance of mathematics and the continuous endeavor to improve its curricula, students' achievement levels are still low and unsatisfying. This is clearly obvious by having a look at the results of the international study test in mathematics and science (TIMSS) where Arab countries including Saudi Arabia were at the bottom of the list of participating countries all over the world (Shehada& Al Qarmaiti, 2016; Al Shalhoub, 2019). Learners' motivation for achievement in mathematics is also low and not convincing. A lot of studies conducted to address the correlation between motivation for achievement and achievement itself revealed that students' levels of motivation for academic achievement in mathematics are low unconvincing (Fan &Weiquia, 2009; Harriman, 2010; Kim, Schallert, & Kim, 2010; Abu AlHadeed, 2011; Templar, 2011; Ali, 2012; Mohammed, 2014; &Tawfiq, 2014). Hence, the problem of the present study problem is determined by learners' low level of achievement and motivation for achievement in mathematics that might be due to the use of traditional method of teaching by high school mathematics teachers. Therefore, improving the level of students' motivation and academic achievement requires the use of effective strategies. Enhancing learning efficiency depends on teacher's choice of appropriate teaching and learning strategies for teaching mathematics(Little, 2009).Furthermore, development of learners' motivation for achievement in mathematics makes the student active in educational situations, releases his energies and liberates his behavior as it makes him more involved in the learning process. It also increases his perseverance in learning situations and makes him exert more effort in retaining different subjects and consequentlyincreases his achievement. Thus, the present study aims to identify the effect of using KWL strategy on the enhancement of high school students' academic achievement and motivation for achievement in mathematics. Mainly, it seeks to answer these questions:

1. What is the effect of using KWL strategy in teaching mathematic on developing the academic achievement of first secondary graders in the public schools in Najran city in Saudi Arabia?
2. What is the effect of using KWL strategy in teaching mathematics on developing the motivation for achievement of first secondary graders in the public schools in Najran city in Saudi Arabia?
3. What is the relationship between achievement in mathematics and motivation for achievement of first secondary graders in the public schools in Najran city in Saudi Arabia?

Method

The quasi-experimental approach depending on the selection and distribution of the sample was used.

Sample

The sample of the present study consisted of (60) first secondary graders enrolled in two sections at Yarmouk Secondary School in Najran city in the academic year 2018/2019. Participants were distributed to control and experimental groups. The control group was taught by the use of the traditional method while their peers in the experimental group studied the chosen module via the use of KWL strategy.

Instruments

The study instruments consisted of:

1. A guide for mathematics teacher to use while teaching the topics of the "Quartet Shapes" module according KWL strategy.
2. A set of worksheets for students to work on the six topics of the chosen unit, namely polygon angles, parallelogram, distinction of parallelogram, rectangle, square and rhombus, and trapezoid
3. An achievement test in "Quartet Shapes" module to check students' higher order thinking skills, i.e. analysis, synthesis and evaluation.
4. A scale for motivation for achievement in mathematics of four main dimensions, level of ambition, self-satisfaction, perseverance, and enjoyment of learning mathematics.

Validity of instruments

The teacher's guide

As soon as the teacher's guide was developed, it was presented to a group of arbitrators specializing in curricula and methods of teaching mathematics. They were requested to check and ensure the appropriateness of the strategy used, designed activities, academic content and teaching performance that help achieving the desired learning outcomes of the "Quartet Shapes" module. After that some modifications, as suggested by the arbitrators, were made and the guide was ready for use.

The worksheets

Prepared worksheets were also presented to the same group of arbitrators to make sure of their consistency with KWL strategy and suitability for implementation to achieve the learning outcomes of the "Quartet Shapes" module. After that some modifications were made in light of the remarks of the arbitrators.

The achievement test

To check the validity of the prepared achievement test, it was first presented to a set of arbitrators who were all experts in teaching mathematics. They were asked to check the items' appropriateness and accuracy. In light of their notes, some modifications were made. After that, it was applied to an exploratory sample of (30) first secondary graders who were not among the main sample. The correlation coefficient between each participant's score and the whole test score was calculated. The result showed that each item in the test was statistically significant (α=0.05) and meanwhile indicating that the test's internal consistency was valid. In addition, test reliability was assured via the use of Alpha Cronbach revealing that it was (0.72).

Motivation for achievement in mathematics scale

Like other instruments, the motivation for achievement scale was presented to the group of arbitrators to ascertain its expressions appropriateness, clarity of items formulation and suitability for participant students' age. The final version consisted of (32) items. After making some modifications, it was applied to an exploratory sample to calculate its internal consistency by extracting the correlation coefficient between each student's score and the total score of the whole test. Furthermore, Alpha Cronbach was used to calculate the scale's reliability and was (0.89) indicating its suitability for the study.

Pre-experimentation of the study

To check homogeneity of participants in the control and experimental groups, they were pre-tested using the study main instruments, i.e. achievement test and motivation for achievement scale.T. test for the significance of differences between the two groups was used. Tables1 & 2 show the results.

***Table 1*:** Significance of differences between the mean scores of students in the pre-achievement test

Group	N	M	SD	DF	T. value	Significance (α=0.05)
Control	30	8.2	27	58	0.79	Not significant
Experimental	30	8.7	2.8			

Results of data analysis in Table 1 reveal that there were no significant differences between students in both groups. In other words, students' achievement levels were homogeneous and equivalent before the application of the experiment.

***Table 2*:** Significance of differences between the mean scores of students in the pre-application of the motivation for achievement scale

Scale dimension	Control group N=30		Experimental group N=30		T. Value	Significance (α=0.05)
	M	SD	M	SD		
Level of ambition	18.5	5.1	19.7	5.2	0.917	Not significant
Self-satisfaction	20.2	4.8	19.5	5.5	0.521	Not significant
Perseverance	21.1	4.6	22.4	6.9	0.906	Not significant
Enjoying learning mathematics	21.6	4.6	20.7	4.2	0.780	Not significant
The whole scale	81.4	10.9	82.2	12.4	0.287	Not significant

Results shown in Table 2 reveals no significant differences between participants' response in both groups to all items involved the four dimensions of motivation for achievement scale. In other words, all participants were homogeneous with regard to their motivation for achievement in mathematics.

After making sure that all participants were homogenous regarding their academic achievement levels and motivation for achievement in mathematics, mathematics teacher, who was the teacher of both groups, started teaching. Traditional teaching methods were used to teach the control group while KWL strategy was adopted to teach students in the experimental group the subjects of the "Quartet Shapes" module. The experiment lasted for three weeks. After that students sat for the achievement test and the motivation for achievement was administered to them for the second time.

II. Findings And Discussion

Findings related to the first question

To answer the first question, "*What is the effect of using KWL strategy in teaching mathematic on developing the academic achievement of first secondary graders in the public schools in Najran city in Saudi Arabia?*"T. test for the difference between the mean scores of students in the control and experimental groups was used. Findings are presented in Table 3.

***Table 3*:** Significance of the difference between students' means scores in the achievement posttest

Group	N	M	SD	DF	T. value	Significance (α=0.05)
Control	30	25.5	4.7	58	2.6	Significant
Experimental	30	29.1	5.7			

Results in Table 9 indicate that there are significant differences (α=0.05) between the mean scores of students in the experimental and control groups in the achievement posttest in favor of the experimental group. In other words, experimental group students outperformed their peers in the control group in achieving the main topics of the "Quartet Shapes" module at analysis, synthesis and evaluation levels. That is, the use of KWL strategy in teaching mathematics developed students' higher order thinking skills, analysis, synthesis, and evaluation as mean scores of students in the experimental group who studied via the utilization of KWL strategy were higher than peers' mean scores in the control group who were taught via traditional ways. These results are, of course, in agreement with the findings of a set of studies like: Ali (2019); Qawasmi (2019); AL Deeb& Al Ashqar (2017); Tamimi (2017); and Aseeri (2016) which showed the effect of using KWL in the promotion of students' achievement in mathematics.

One interesting explanation for this result can be due to some facts. First, the use of KWL has contributed to the variation of activities used that helped students comprehend aspects of learning involved in the "Quartet Shapes" module. Second, the use of KWL strategy has aroused students' interest and excitement in the learning process, and consequently increased their motivation to acquire aspects of learning in mathematics. Third, students' participation in discussions and dialogue led to the provision of an educational atmosphere helping students to understand and comprehend better. Fourth, using KWL made students positive and active, which helped increasing their activity to acquire information and make predictions for meaningful learning based on understanding and retention and away from memorization.

Findings related to the second question

To answer the second question, "*What is the effect of using KWL strategy in teaching mathematics on developing the motivation for achievement of First secondary graders in the public schools in Najran city in Saudi Arabia?*" T. test for the difference between the mean scores of students in the control and experimental groups was used. Findings are presented in Table 4.

Table 4: Significance of the difference between students' mean scores in the motivation for achievement scale post application

Motivation dimensions	Control group N=30	Experimental group N=30		SD	T. value	Significance
Level of ambition	23.0	5.1	32.6	2.9	8.9	Significant (α=0.01)
Self-satisfaction	24.6	4.9	36.5	3.7	10.6	Significant (α=0.01)
Perseverance	27.7	4.8	33.0	3.2	5.0	Significant (α=0.01)
Enjoying learning mathematics	26.1	4.0	29.4	5.4	2.6	Significant (α=0.01)
The whole scale	101.5	8.6	131.6	8.1	12.5	Significant (α=0.01)

Results in Table 4 indicate that there are significant differences (α=0.05) between the mean scores of students in the experimental and control groups in the post application of the scale of motivation for achievement as a whole and its all minor aspects in favor of students in the experimental group. That is, motivation for achievement of students in the experimental group was better promoted than the motivation of their counterparts in the control group because of the utilization of KWL strategy. These results, for sure, corroborates the findings of a group of studies such asAkhoIrshaideh (2017); Hajibi (2017); Saleh (2017); Barnawi (2018) and Al Ramali&Olaijah (2019) that emphasized the impact of varied teaching strategies on the enhancement of motivation for achievement. This result can be explained based on a group of factors like students self-reliance to acquire mathematical experience according to KWL stagesbesidesthe planning and activation of knowledge; motive; and conduct in addition toin-advance determination of goals, which facilitates assessment of students' progress in completing the educational tasks. Furthermore, The learner's learning environment arrangement, in the way he preferred, that enabled him to focus attention, overcome dispersions, and complete the work without being disrupted or bored, besides his perseverance to reach the aspiration he wished was also effective in raising his motivation. The contribution of KWL to increasing the attention of learners and motivation for learning because of the sense of their capability was so effective, too.

Findings related to the third question

To answer the third question, "*What is the relationship between achievement in mathematics and motivation for achievement of first secondary graders in the public schools in Najran city in Saudi Arabia?* Pearson correlation coefficient for students' grades in the post achievement test and the post application of motivation for achievement scale was calculated. Table 5 shows the results.

Table 5: Pearson correlation coefficient between students' achievement and motivation

Study variables		Achievement	Motivation for achievement
Achievement	Pearson Correlation	1	0.56**
	Sig. (2-tailed)	--	0.000
	N.	30	30
Motivation for achievement	Pearson Correlation	0.56**	1
	Sig. (2-tailed)	0.000	--
	N.	30	30

** Correlation is significant at the 0.01 level (2-tailed).

Results of correlation between achievement and motivation for achievement indicate that Pearson correlation coefficient was (0.56) indicating that the correlation between both variables was positive and significant (α=0.01). That is, there was a mutual effect between both dependent variables where development of achieved improving students' motivation and meanwhile promoting students' motivation enhanced their motivation. Explanation of this result can be due to students' acquisition of mathematical experiences according to KWL; arrangement of the learning environment; improved enjoyment of mathematics learning and improved learning process; sense of ability to achieve better in mathematics.

III. Conclusion

The present study aimed to investigate the effect of using KWL strategy in teaching mathematics on developing students' achievement and motivation for achievement. Analysis of data collected showed that KWL utilization in teaching mathematics to first secondary graders who represented the sample of the present study was effective in improving the levels of achievement of participants in learning mathematics. It was effective in improving participants' motivation for learning mathematics, too. The relation between achievement and motivation was also significant and positive due to the use of KWL strategy. Therefore, findings of the present study could shed light on the importance for in charge people of the educational process to account for training secondary school mathematics teachers to use the KWL strategy. They should encourage using KWL strategy for all educational stages, not only the secondary one, and involve its principles and stages in all teacher guides. More importantly, they should work on increasing students' motivation because of the important role it plays in developing students' achievement. On the other hand, researchers are recommended to conduct studies that address the effectiveness of using KWL strategy in teaching mathematics to develop other aspects of learning, such as self-satisfaction and various thinking patterns… etc. Studies that identify the effect of other teaching methods that could contribute to the development of achievement and motivation among students of different educational stages are also encouraged.

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