The Effectiveness of using the (K.W.L.H) Strategy for Teaching Mathematics in Acquiring Mathematical Concepts and Developing Mathematical Thinking Skills among First-Grade Intermediate Students

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Abstract

The current Study aimed to reveal the effectiveness of the strategy (K.W.L.H) for teaching mathematics in acquiring mathematical concepts and developing mathematical thinking skills among first-grade intermediate students. The experimental approach was followed, through the experimental design, with a measurement: pre- and post-by two groups, one of which was an experimental number of (34) students who studied the unit using the strategy (K.W.L.H)), and another control numbered (34) students who studied in the usual way, and they were randomly selected and appointed, and the Study materials and tools were applied, as the Study materials were: preparing the teacher's guide, and an activity booklet according to the strategy (K.W.L.H), and the tools were: testing mathematical concepts and testing mathematical thinking skills. Among the most important findings of the Study are as follows:

1. There are statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical concept acquisition test in favor of the experimental group in the dimensional application.

2. The existence of a great effectiveness of the independent variable (K.W.L.H) in acquiring mathematical concepts at the level of remembering, understanding and application and in the total degree of testing mathematical concepts among students of the experimental group compared to the control group in the post-application.

3. There are statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical thinking skills development test for the benefit of the experimental group in the dimensional application.

4. The existence of a great effectiveness of the independent variable (K.W.L.H) in the development of mathematical thinking skills, namely: (induction, generalization, conclusion, expression with symbols, modeling, reasoning and causality, criticism and evaluation) and in the total degree of testing the mathematical thinking skills of the experimental group students compared to the control group in the dimensional application.

Keywords: Teaching, mathematical concepts.

1. Introduction

The role of education in our time is one of the driving strengths of society from the state of slow growth to the state of comprehensive and rapid growth in the field of progress and development in human and economic resources, a path that directs society and the individual to face the challenges of the twenty-first century, which was characterized by advanced information progress, which is unprecedented before. Defending against the changes of globalization, which is a weapon for investing in human resources, which represent the main component of economic and social progress.

Mathematics is one of the first sciences to keep pace with contemporary and future developments, which by realizing the importance of its applications in life and exploiting it in the right ways contributes to scientific and technical progress in the Kingdom of Saudi Arabia, which in turn expands the cognitive aspect of man through its applications in life;These applications have become an essential thing in mathematics education to make its teaching and learning meaningful. (Atallah, 2021)

Concepts play a fundamental role in all educational courses, as they represent one of the basic components of educational content in various fields, and concepts are defined as verbal phrases that indicate a set of ideas and abstract information of experiences and things, and have common characteristics, and are distinguished from facts by generalization and abstraction, so mathematical concepts came within the classification of knowledge, which is the important base on which the rest of the knowledge is built; Therefore, it is important to teach concepts in mathematics, and the study of the cognitive structure of any mathematical subject begins with clarifying and developing concepts in appropriate ways and strategies. (Qarqash, 2019; Mansour, 2021)

It is important to teach mathematical concepts that it classifies facts and reduces their complexity, allows organization and linking between groups of facts and phenomena so that the relationships between them can be perceived, and also reduces the need for relearning when faced with any new situations, and helps to guide, predict and plan any activity, and has a lot to do with the lives of students more than scattered scientific facts.The acquisition of mathematical concepts and the awareness of the relationships between them, begins with mastering the skills associated with them, it is important to develop the mathematical thinking skills of students, and this emphasizes the importance of these skills in acquiring mathematical concepts and improving the level of performance in mathematics topics, and thus mathematical concepts and mathematical thinking skills have received great attention from educational specialists compared to other components of mathematical knowledge. Attic, 2012; Al-Mashhadani, 2020)

The acquired mathematical thinking skills are the intellectual framework that governs the relationship between things, and this thinking was called mathematical because it is easy to link it to mathematics, and this concept is not limited to arithmetic operations, but extends to symbols, equations and geometric shapes, and mathematical thinking skills are mental activity that is based on many mathematical skills, such as: Conclusion, induction, expression of mathematical symbols, awareness of the relationships between them, and logical thinking in order to

understand and derive ideas and results that help students reach the solution of mathematical problems. (Attia, 2015; Al-Harbi and a fatherand Lum, 2019)

One of the models that have been clearly associated with the development and organization of thinking (K.W.L), which is one of the models associated with metacognition and is based on a set of arranged and planned steps and procedures listed in the teacher's manual, which requires the teacher to carry out activities, and the use of various methods, methods, means and methods of evaluation, which contribute to organizing and summarizing thinking, in three columns that require an answer to Three questions, about learning knowledge about the subject, and what will he learn? And what do you know about the subject under study? Which leads to the arrangement of ideas, and codify the learner's efforts in study and Study, and the strategy (K.W.L.H) emanating from the model (K.W.L) that was derived from the ideas of Piaget, and called the strategy of knowledge formation developed by Donal Ogal to fall under this teaching model under cognitive education models, which is a set of organized actions and steps carried out by the learner in the classroom in light of the teacher's directions.

In light of the importance of using modern strategies in teaching that help acquire mathematical concepts and develop mathematical thinking skills, there is a need for other methods and strategies that help acquire mathematical concepts in their correct sense and develop the skill of mathematical thinking among students, to enable them to continue learning according to a clear and codified basis, to make the learning process clearer and more useful.

Study problem

One of the general directions in the mathematics curriculum document issued by the Education and Training Evaluation Commission in the Kingdom of Saudi Arabia in 1440 AH / 2019 AD is to present mathematical concepts in contexts of daily life in the form of realistic problems that are meaningful to the learner, and to employ mathematical modeling in converting them into mathematical problems, and then solving them according to specific and planned strategies, and focused in school mathematics curricula on developing the learner's thinking as a goal he seeks to achieve. The student is aware of important mathematical concepts that enable him to continue studying mathematics and other areas of learning, acquiring the mathematical skills he needs in his life, future study and work environment, and able to conduct them fluently, mastering the mathematical thinking and reasoning skills that help him to create.(Education and Training Evaluation Commission, 2019)

When the Studyer worked during the professional service, it was noted that there was a defect in the way of acquiring new mathematical concepts, and a decrease in the level of mathematical thinking skills, which resulted in the difficulty of linking concepts to integrate knowledge in the mind, and deficiencies in planning, evaluation and other mathematical skills, and this is consistent with the results of some studies that showed this weakness, such as the study of Al-Shammari (2017), which revealed The results showed that there is a weakness in the acquisition of calcareous mathematical concepts for them, as alternative perceptions were found for a number of algebraic mathematical concepts, where the percentages of students with alternative perceptions ranged between (13.5%-90.3%), and the percentage of alternative concepts (73.2%), as shown by Zakir's study (2021), which aimed To identify the reality of developing thinking

skills in mathematics among general education students in the Kingdom of Saudi Arabia, and the study found that (50%) of the Study targeted the intermediate stage, compared to other stages, and with regard to the targeted thinking patterns, mathematical thinking came in first place by (21%), and the results also resulted in that the most obstacles to developing thinking skills in mathematics are those associated with the teacher by (45%)From the above, it is clear that educators seek and need strategies that help acquire mathematical concepts and develop students' mathematical thinking skills.

After readings in previous Study and studies, the Studyer found that it is possible that the strategy (K.W.L.H) is effective in teaching and learning mathematics for its clear sequence in the processes of restoring and acquiring the old and new mathematical concept and linking them, and it may be good in developing the necessary mathematical thinking skills among students, and from this point of view the Study aims to reveal the effectiveness of the strategy (K.W.L.H)) to teach mathematics in the acquisition of mathematical concepts and the development of mathematical thinking skills among first-grade intermediate students.

Study Questions

The Study seeks to answer the following questions:

1. What is the effectiveness of using the K.W.L. strategy? H) In the acquisition of mathematical concepts among first-grade intermediate students?

2. What is the effectiveness of using the K.W.L. strategy? H) In developing mathematical thinking skills among first-grade intermediate students?

Study Objectives

The current Study aims to reveal the effectiveness of:

1. Detection of the effectiveness of the strategy (K.W.L. H) In the acquisition of mathematical concepts among first-grade intermediate students.

2. Disclosure of the effectiveness of the (K.W.L.H) strategy in developing mathematical thinking skills among first-grade intermediate students.

2. Importance of Study

The importance of current Study is as follows:

First: Theoretical importance:

The importance of the study follows from the importance of the (K.W.L.H) strategy, which is one of the strategies associated with organized self-learning, which calls for previous knowledge and linking it to new knowledge, and contributing to the theoretical literature of the (K.W.L.H) strategy for teaching mathematics, to draw the attention of Studyers to carry out many studies and Study on different topics.

Second: Applied Importance:

1. The Study provides a guide for the teacher using the (K.W.L.H) strategy, which may enable mathematics teachers to acquire mathematical concepts for first-grade intermediate students and develop their mathematical thinking skills.

2. Provides an activity booklet using the K.W.L.H strategy, which may enable first-grade students to acquire mathematical concepts and develop their mathematical thinking skills.

3. Provides an analysis of unit concepts in the first-grade intermediate mathematics course that math teachers may be able to use in identifying the concepts contained in the unit.

4. It provides math teachers with a test in mathematical concepts and mathematical thinking skills as a model that can be useful in preparing other similar tests.

Search terms

The research includes the following terms:

(K.W.L. H) Strategy:

Rahim (2013) defined it: "One of the strategies based on constructivist theory, which is based on activating previous knowledge and making it the basis on which new knowledge is built, and consists of a set of steps and practices that the teacher follows in the classroom with the aim of enabling learners to activate their previous knowledge in order to understand the text and employ it in line with the cognitive structure." (f. 436)

The K.W.L.H strategy is defined as: "A metacognitive strategy, consisting of several steps organized and arranged in a table, represented by K to denote the word Know, which means what do you know about the subject? W stands for Want and means what do you want to know? L to denote the word Learning and means what did you learn? It is a strategy that aims to recall the previous identifier and make it a starting point to link it to the new information contained in the read text." (Abu Safar, 2014, p. 23).

It is defined procedurally as: one of the strategies of thinking beyond knowledge based on constructivist theory, which includes a set of organized and ordered steps carried out by the first-grade intermediate student during her study of the algebra and functions unit for the first semester, and plans in the form of columns, requiring answering four questions revolving around the student's knowledge of previous information she has related to the unit's topics, what she will learn from the new topic, what she has already learned from the topic, and what she wants to know after the information Relevant.

Mathematical concepts:

Al-Bawi and Al-Shammari (2020) defined mathematical concepts as: "a mental construction that results from the perception of relationships between phenomena, events, and things for the purpose of organizing them into fewer categories" (p.6).

It is defined procedurally as: It is the basic vocabulary in the unit of algebra and functions for the first intermediate grade of the first semester. The student's ability to acquire mathematical concepts is measured using the K.W.L.H strategy through the mathematical concepts test prepared for this.

Mathematical thinking:

Mathematical thinking is defined as: a mental activity carried out by the learner to Study mathematical topics using some relevant information in linking the situations presented to them and drawing a conclusion related to introductions and problem solving. (Sevin, 2014, p. 164).

It is defined procedurally as: a set of mental processes that demonstrate the ability of the first intermediate grade student to use mathematical thinking methods to solve mathematical problems and deal with the various mathematical problems faced by the student through the following skills: (induction, conclusion, generalization, coding, modeling, reasoning and causality, criticism and evaluation), and the development of the skill is measured after using the strategy (K.W.L.H) by testing mathematical thinking skills in the algebra and functions unit for the first semester prepared for that.

Search limits

Search is limited to the following limits:

Objective limit: The first unit "Algebra and Functions" of the mathematics course for the first intermediate grade for the first semester of the year 1443 AH-1444 AH.

Human limit: First grade intermediate students in the city of Abha.

Spatial limit: The Study was applied in Sultan City Middle School in Abha due to its proximity to the Studyer's residence.

Time limit: The Study was applied in the first semester of 1444 AH.

Theoretical framework of Study

The strategy of (K.W.L.H) and its role in developing mathematics learning outcomes among middle school students

The most important characteristic of teaching strategies is that they work on a balance between conducting the activity, acquiring more information todevelop the process of cognitive growth, developing the ability to take responsibility, the ability to participate positively, and working on the transfer of the impact of learning and linking between the previous experiences of the learner and new information, as well as having a role in correcting and correcting the wrong construction.

Constructivist theory strategies in teaching are strategies based on cognitive construction, that is, they are based on the links between what the individual learns from ideas and what he has gained from previous experiences and what he masters of mental skills in knowing the links between them and the way he organizes them, the constructivist theory is based on the principle of the learner who enters the classroom and carries with him his knowledge and previous beliefs in his cognitive structure, and the constructivist theory proceeds from the fact that learning is effective when the learner feels that it is meaningful, which is the basis of Behavior modification. (Al-Moussawi, 2015)

(K.W.L) is one of the metacognitive models based on constructivist theory, which the learner performs in order to achieve learning in a conscious and problem-aware manner, along with the various procedures that require the ability to self-control the learning processes in order to reach the desired result, and the model (K.W.L) is called the self-schedule and the model of previous and acquired knowledge in teaching, and this strategy was invented by Ogle 1986 In the United States of America, it consists of three basic stages, and these stages have been developed into several different strategies, including (K.W.L.H). (Al Ghuriri, 2017)

The K.W.L.H strategy was first used as a reading strategy, but it began to be widely used in various educational subjects such as teaching learning, so the application of this strategy supports the learning processes of learners and encourages their understanding.(Bogdanović et al.,2022)

Each letter of the strategy is an abbreviation of the word for the effectiveness through which the thought process is practiced, which is as follows:

- K: To denote the word (Know) that is specific to the question: What do we know about the subject? (what we know about subject?), which represents the first step of the strategy, through which learners can recall their prior information about the topic.

- W: To denote the word "want" for this question, what do we want to know? (what we want to find out?), which instructs learners to determine what they want to learn and achieve through this topic.

- L: To denote the word "Learn" that is specific to the question: What did you learn? (what we learned?), which wants learners to evaluate what they have learned from the subject, and the extent to which they benefit from it.

- H: To denote the word "how" that is specific to the question: How can we learn more? (how we can learn more?) which means helping learners to obtain more learning, discovery and Study in other learning resources, in order to develop their knowledge and achieve their expertise in this subject. (Khudeirat, 2019)

Based on the foregoing, education in this strategy requires that a table be distributed to learners that includes four columns, each column is allocated to a stage of learning according to this strategy that was mentioned and represented in the previous questions, and the following is the design of the strategy table in Table (2-1):

Table (2-1) StrategyK.W.L.H.)

H	L	In	K
How	Learning	Want	Know
How do I learn more?	What do I learn?	What do I want to know?	What do I know?
How do I learn more?	What did you learn?	What do I need to know?	What do I know about it?

Definition of strategy (K.W.L.H)

The K.W.L. model is defined as: "a set of sequential educational steps, in which each letter symbolizes a step of the educational process, which is based on asking questions about the student's previous experiences about the topics included in the unit, what he wants to learn, and what he should reach, with the aim of activating thought processes and contributing to deepening

understanding and developing thinking skills before and during the lesson, and carrying out various activities in cooperative groups." (Abu Ataya and Abu Hamada, 2018)

Greenwood (2019) explained that the K.W.L. strategy is used as a structural or graphical organizer to plan the entire class topic, and it is a simple but logical support that helps students organize their thinking and helps them see something more clearly in the topic planning process.

Strategic Objectives (K.W.L.H.)

The main role in the educational process was represented by the teacher, and after the educational transformations, the learner is now the one who represents this role, and through the use of the (K.W.L.H.) strategy, which aims to integrate the learner within the learning process so that he becomes more active and effective; Organizing his ideas, raising his motivation, retrieving previous knowledge and linking it to new knowledge, enabling the learner to manage and control the learning process, and providing him with the opportunity to extract new ideas and information contained in each topic. (Al Ghuriri, 2017)

The use of this strategy also aims to provide the opportunity for learners to analyze certain concepts, identify what information they know, that they would like to know, learn about what has been learned, and how to learn (Turgut, 2017).)

The K.W.L.H strategy is based on a set of specific learning objectives, which include:

1. Analyze concepts effectively: This strategy is used to analyze complex concepts and identify things that need to be learned.

2. Enhance interrogative skills: This strategy is based on questions and answers, which requires learners to interrogate in an effective manner and search for answers.

3. Enhance critical thinking skills: This strategy helps learners to critically analyze information and make appropriate decisions.

4. Enhance communication skills: This strategy is used to enhance communication skills among learners, as they are encouraged to exchange ideas and opinions on different concepts.

5. Enhance fun and excitement: This strategy is used to promote fun and excitement in the learning process, as learners are encouraged to actively participate in the educational process and enhance their desire to learn more about mathematical concepts.

6. Motivate students for continuous learning: This strategy is used to motivate learners to continuously learn and continue to develop their mathematical skills, as they are encouraged to explore mathematical concepts more deeply and expand their knowledge.

7. Improve thinking skills: This strategy is used to improve the thinking skills of learners, as they are encouraged to think critically, solve problems, and use imagination and creativity in developing solutions to various mathematical problems.

Encouraging inquiry and exploration: This strategy is used to encourage inquiry and exploration in learners, where they are encouraged to Study, explore, collect and analyze information to better understand mathematical concepts (Kim & Han, 2 018 Ozdemir & Aslan, 2017;)

It is clear that the strategy (K.W.LH) provides many advantages and benefits to the learning process in the field of mathematical concepts, and by improving thinking skills and enhancing fun and excitement in the educational process, enabling learners to achieve better results and improve their performance in sports subjects.

The advantages of using the K.W.L.H strategy in teaching mathematics are as follows:

1. The strategy develops metacognitive thinking skills with high effectiveness for the learner.

2. Stimulates thinking before, during, and after learning, which helps to examine and scrutinize what is required.

3. It emphasizes self-reliance and activating the principle of self-learning, which makes learning meaningful.

4. Develops the learner's cognitive structure, and organizes previous experiences and knowledge to receive new ones.

5. Stimulate reflection, activate previous knowledge and link it to new knowledge.

6. It facilitates the learning of wide-ranging topics and organizes internal and external interdependence.

7. Training on education report and self-direction during the learning process.

Steps to implement the K.W.L.H Strategy:

Attia (2014) stated that the implementation of the lesson within the framework of this strategy is carried out according to the following steps:

1. Learn about the topic of the lesson:

The teacher begins by mentioning the title of the lesson and writing it on the board, then shows the general framework of the topic, and provides a brief overview of it.

2. View the strategy self-schedule:

The teacher presents the strategy table on the board and explains it, and shows how to use it in learning, specifying the duration of time, and the type of information that will be fixed in each column.

3. Determine the method of study:

The teacher determines whether in-class learning is individual or grouped.

4. Fill in the first column (K) of the table (what does the learner know about the topic of the lesson?):

The teacher asks the learners to fill in the first column with the information they already know about the topic, so that each of them has a copy of the table or for each group depending on the study style used.

5. Fill in the second column (W) of the table (what does the learner want to know about the topic of the lesson?):

Learners determine what they want to know or learn from the new topic, and thus determine the objectives of the lesson topic; to guide the reading path and the Study plan and write them in the form of questions to answer during their study of the topic.

6. Study the topic in depth:

Examine the topic in search of answers to the learners' questions written in the second column of the table, and benefit from their previous experiences that were noted in the first column.

7. Fill in the third column (L) of the table (what did you learn from the topic of the lesson?):

In the third column (What did you learn?), learners write down what has been learned and reached after studying the topic in depth and carrying out the accompanying activities.

8. Evaluation of what has been achieved:

In this step, learners compare what was written down in the second (W) and third (L) columns, and know what has been achieved from the set goals.

9. Fill in the fourth column (H) of the table (how do I know more about the topic of the lesson?)

Learners try to find more information related to the topic to achieve better learning by reporting, summarizing, identifying areas, and providing an oral presentation of what has been learned.

The role of the teacher when applying the K.W.L.H strategy in teaching mathematics:

The study of (Abdul Amir and Nasih 2018; Taha, 2019; Ali, 2019; Al-Ghamdi, 2019; Al-Fatairi and Qutb, 2020) stated the role of the teacher during the application of the (K.W.L.H.) strategy in teaching mathematics subjects, which were represented in the following:

- Planning the objectives of the lesson according to the chosen topic that helps to achieve those goals, and preparing the strategy schedule.
- Distributing learners into groups and determining the roles of each group member, then distributing the K.W.L.H. strategy table to all groups.
- Directing learners towards reading the topic, and then guiding them to ask themselves the following question: (What do I know about the topic?) with the need to help them generate as many questions as they progress in using the strategy.
- Detecting and organizing previous knowledge as a basis for new learning, then writing ideas in the first column, with the need to accept any idea related to the topic, even if it is wrong, while correcting errors that were built on their previous knowledge and experience.
- Attracting learners' attention to the topic, and provoking their motivation towards learning by maintaining their activity, by giving them sufficient opportunities to think before intervening and solving the question himself, so that their role is not negative.

- The teacher should ask the learner before reading (what do you want to know about the topic?) and get ideas and write questions about them.

- Maintain calm, adjust classroom conditions, and manage discussion groups so that each team can complete the task assigned to it.

- In the reading stage, after the learner puts the question (what do I want to know?), here the teacher begins to direct them to set the goal for themselves from reading, and the need to start formulating questions in general.

- Follow-up dialogue with the generation of questions by calculating the appropriate time for the amount of development of students' fluency, the more questions developed by each learner, the more effective the strategy gives, with the need to repeat the questions with learners during their responses, so that the information is proven and the questions are not repeated with other groups.

- Provide the opportunity for learners to read the topic and fill in the third column of the table (what have you learned about the topic?) and can be done as a home activity.

- Enhance learners' self-confidence, especially those with low achievers, and help specific team members on how to stand properly in case of confusion.

- Discuss with learners what they record in the columns of the strategy table.

- Evaluate the final performance to see the extent to which the desired goals have been achieved, provide feedback and the extent to which they achieve the desired learning.

The role of the learner when using the K.W.L.H strategy in teaching mathematics:

In (Abdulamir and Nasih, 2018; Taha, 2019; Ali, 2019; Al-Fatairi and Qutb, 2020) the role of learners when applying the K.W.L.H strategy in learning the topic at hand, which was summarized in the following stages:

1. The first stage: reading the topic of the lesson, absorbing and classifying the ideas presented in it into basic and sub-axes, and at this stage activates the knowledge of the learners, and recalls their ideas that they have learned and the data and information that passed through them and are related to the new topic, and determines what he knows about the topic at hand, and then writes down this information in the first column (K) of the table, including training in practicing cooperative thinking with group members and respecting the opinions of others.

2. The second stage: in which learners define the objectives of the topic, and formulate them in the form of questions that meet cognitive needs based on previous knowledge and need answers, correct information and misinformation, and write what is intended to be learned about the new topic in the second column (W) of the table.

3. The third stage: the learner practices independent thinking about the issues and ideas around which the topic revolves after studying, then the learners fill in the third column (L) of the table with what they have learned from the activities, and what the learners have learned may exceed the limits of the answers to the questions that have been installed in the second column

(W), meaning that they get additional information, then the learners compare what was asked in the second column (W) and the third (L) in the strategy table.

4. The fourth stage: At this stage, learners develop new questions that require further Study for the purpose of increasing information, especially that learners after studying the topic can have other questions in their minds that were not asked before studying the topic, and this means that learning will be a continuous process that does not stop at a certain limit, and the teacher suggests learning resources and other ways to increase knowledge about the subject, and it is recorded in the fourth column (H) of the table.

It is clear from the above presented about the strategy (K.W.L.H) its agreement with the roles of the modern teacher within the limits of guidance and guidance in the education process, and the diversity of the method of study as required by the educational situation, and despite the ease and sequence of its procedures, it is of great benefit to the learner, but may become a fixed educational pattern that pushes for the continuation of the self-learning process in an organized manner.

3. Previous studies:

studies that dealt with the (K.W.L.H) strategy

Al-Enezi's study (2019) looked at the impact of the K.W.L.H self-learning schedule strategy on the achievement of sixth grade students in the regular fractions and decimals class, and in their attitudes towards school mathematics, and the study conducted the first semester (1438/1439 AH) at King Khalid bin Abdulaziz Primary School, in Arar, Saudi Arabia, and followed a semi-experimental design, so an achievement test and a measure of attitude towards school mathematics were applied to two groups: One of them is a control (27 students), and the other is experimental (26 students): before and after, and the study showed the equivalence of the two groups before in the achievement test, and on the scale of the trend towards school mathematics, at the level of significance ($0.05 \geq \propto$), while the experimental group outperformed the control group after statistically significant differences, at the level of significance ($0.05 \geq \propto$) and the size of a large impact: in the achievement test, and on the scale of the trend towards school mathematics.

Ali's Study (2019) aimed to identify the effectiveness of using the previous knowledge activation strategy (KWL) in teaching mathematics on achievement, and developing self-regulation skills among secondary school students, and the Study sample consisted of (60) students from the first grade of secondary school, divided into two groups; an experimental (30) students studied using the KWL strategy, and a control of (30) students studied in the usual way, and the Studyer prepared Study materials and tools, including: An achievement test in the "quadrilateral" unit, and the teacher's guide to teaching the unit according to the previous knowledge activation strategy KWL and students' worksheets, and the results showed: There are statistically significant differences between the average scores of the students of the experimental and control groups in the post-application of the achievement test for the benefit of the experimental group students.

Al-Ghamdi's Study (2019) aimed to find out the impact of using the K.W.L.H strategy on the development of engineering thinking among middle school students in Bisha Governorate, and to achieve the goal, the experimental approach based on semi-experimental design was used, and a test of engineering thinking was prepared for the "measurement" unit applied to a random sample of (43) female students of the first intermediate grade, and it was randomly divided into two equivalent groups: one of them was experimental (23) students, who studied the measurement unit using the K.W.L.H strategy., and the other control studied in the traditional way, and the study experiment lasted three weeks, and applied the engineering thinking test before and after the two groups, and the results of the Study resulted in a statistically significant difference at the level of ($0.05 \geq \propto$) between the average scores of the students of the experimental and control groups in the post-application of the engineering thinking test for the benefit of the experimental group.

The study of Al-Qawasmi et al. (2020) aimed to investigate the effectiveness of using the (KWL) strategy in improving the learning of first-year secondary students mathematical thinking, in which the experimental approach was used, so the mathematical thinking test was applied to (67) students who were chosen in the available way, where they were distributed into two groups: an experimental one consisting of (34) students who learned through the (KWL) strategy, and a control consisting of (33) students who learned in the usual way, After conducting statistical methods, the results of the study showed that the students of the experimental group achieved the highest arithmetic averages on the mathematical thinking test, and on the other hand, the students of the control group achieved few arithmetic averages, and the results of the test (T) revealed that there were statistically significant differences between the two groups in the test, and these differences came in favor of the experimental group that received its education through the (KWL) strategy.

The study of Al-Fatairi and Qutb (2020) aimed to find out the effectiveness of the self-schedule strategy k.w.l in developing creative thinking skills in mathematics and the trend towards it among sixth grade students in Dammam, so the Studyer used the experimental method, and the Study experiment was applied to a sample of (92) students, randomly selected representing two groups, divided into an experimental group of (46) students, and a control group of (46) students, and the Study experiment was applied in the second semester of the academic year 1439/1440 AH, where the Studyers designed activities Learning, preparing content analysis, and preparing the teacher's guide and activity booklet for the student in accordance with the self-schedule strategy K.W.L., the Study sample was subjected to the creative thinking test and the scale of the trend towards mathematics prepared, according to the pre- and post-, then the results were treated statistically using the program of statistical packages for the social sciences ssps, and the results resulted in a statistically significant difference at the level of ($0.05 \geq \propto$) between the average scores of the students of the experimental group and the control group in the application of the pre- and post-creative thinking test, as well as the scale of the trend towards mathematics in favor of the post-application, and the results of the Study resulted in a statistically significant difference at the level of significance ($0.05 \geq \propto$) between the average scores of the students of the experimental group and the control group in the test of creative thinking dimension as a whole and its sub-skills, as well as the scale of the trend towards dimensional mathematics in favor of the experimental group.

The study of Bougherra et al. (2022) aimed to clarify the need to rely on independent (self-learning) in light of the Corona pandemic, by adopting the self-learning schedule K.W.L. as an active learning strategy that depends on involving the student in the learning process, and gives him independence in obtaining information, and does not depend on indoctrination in the traditional way, which was questioned by the current circumstance of the teaching process, during which self-learning and the KWL strategy were introduced, and the role of the learner in the strategy K.W.L, with a mention of proposed steps to implement the K.W.L self-learning schedule strategy as an alternative to collective learning in light of the Corona pandemic, and concluded by mentioning the contributions of the self-learning schedule strategy / KWL in light of the Corona pandemic.

The study of (Al-Enezi, 2019; Ali, 2019; Al-Ghamdi, 2019; Al-Qawasmi et al., 2020; Al-Fatairi and Qutb, 2020; Bougherra et al., 2022) agreed with the current Study on the K.W.L.H. strategy in teaching mathematics.

4. Search Procedures

Study Tools:

1. Testing mathematical concepts in the "Algebra and Functions" unit of the mathematics course for the first intermediate grade - first semester / edition 1444 AH-2022 AD.

2. Mathematical thinking skills test in the "Algebra and Functions" unit of the mathematics course for the first intermediate grade - first semester / edition 1444 AH-2022 AD.

The two tests are designed as follows:

First: Testing mathematical concepts in the "Algebra and Functions" unit of the mathematics course for the first intermediate grade - first semester

The test of mathematical concepts included in the first unit "Algebra and Functions" of the mathematics course for the first intermediate grade for the academic year 1443 AH-1444 AH was prepared, and it was applied before to the experimental and control groups, and then after using the (K.W.L.H) strategy on the experimental group and the usual method for the control group, and this test was prepared as follows:

1. Determining the objective of the test: The aim of the test is to reveal the level of first-grade intermediate students in acquiring the mathematical concepts included in the first unit "Algebra and Functions" as a learning outcome for the use of the (K.W.L.H) strategy in teaching.

2. Preparation of the specification table for the test: After analyzing the concepts of the "Algebra and Functions" unit from the mathematics course for the first intermediate grade of the first semester and preparing the lessons in the teacher's manual, a table (4-4) of the specifications of the mathematical concepts test was built according to it and designed as follows:

Table (4-4) Specifications of the Mathematical Concepts Test for First Intermediate Grade Students in the Algebra and Functions Unit

By topic					
Subject		Number of mathematical concepts	Number of questions	Question score	٪
Forces and exponents		9	16	1	34.61%
Order of operations		2	3	1	7.69%
Algebraic variables and expressions		4	5	1	15.38%
Equations		4	4	1	15.38%
characteristics		2	2	1	7.69%
Equations and functions		5	5	1	19.23%
Total		26	35		100%
By level					
Level	Number of concepts	Question numbers	Number of questions	Question score	٪
Remember	5	1.3.7.20.32	5	1	SR29.14
Understanding	11	5.8.9.10.11.12.13.15.16.17.22.23.25.29.30.31	16	1	71.45
Application	10	2.4.6.14.18.19.21.24.26.27.28.33.34.35	14	1	40
Total		35 questions			100%

3. Preparation of the initial image of the test: The test was designed from the multiple choice type, and it consists of (35) questions, and the test relied on the new concepts in the first unit "Algebra and Functions" of the mathematics course for the first intermediate grade for the first semester 1443 AH-1444 AH.

4. Estimating the validity of the test: To ensure the truthfulness of the test, its initial image was presented to the scientific supervisor of the Study, and then presented to a group of arbitrators specialized in curricula and teaching methods in mathematics, and mathematics supervisors and teachers for the intermediate stage, Appendix (2), to benefit from their opinions and observations about the appropriateness of the test for the Study sample, and that it measures what was set to measure, and the soundness of the scientific and linguistic accuracy of the test questions, and correcting and amending what was agreed upon by the arbitrators.

- The tool has been linguistically reviewed, modified and formatted according to the notes.
- Formulate the test instructions well with an example of the solution method.
- Rephrase some questions, such as: (30, 29, 27, 23, 22, 2).
- Consider alternatives to some questions, such as (23,25).

The final test became applicable to the sample Appendix 5.

5. Correction of the test: The test is corrected by giving one score for each question in the test if the correct answer is chosen, and giving a score of "zero" if the wrong answer is chosen in the question, and then the total score of the test is (35) points.

6. Formulation of test instructions: The instructions were written on the first sheet of the test, which included clarifying the purpose of the test, describing the test vocabulary in terms of the number of questions and alternatives, explaining how to answer multiple choice questions in the answer sheet of the test, and providing an example that illustrates this.

7. Exploratory experiment of the test: The test was applied to a sample of (36) female students of the second intermediate grade in another school, in order to determine the following:

- The appropriate time for the test: The appropriate time was calculated to apply the test to the basic sample after re-applying the test to the exploratory sample in the Study, by recording the time taken by the first student who finished the test, which was estimated at (40) minutes, and recording the time taken by the last student who finished the test, which was estimated at (50) minutes, and by calculating the average time for them, the result showed that the appropriate time to apply the test is (45) minutes.

- Difficulty coefficients for test items: The difficulty coefficients for each of the test questions, which are to some extent acceptable, were calculated in Table (4-5), so that the difficulty coefficients ranged between (20.0-60.0), considering that the acceptable ranges between zero and one (Abdul RahmanN, 2011).

- Discrimination coefficient for test items: To calculate the discrimination coefficient for the paragraphs of the mathematical concepts test, the following steps were followed:

I- Correcting the answers of the students of the survey sample for each question and then recording the final grade for each student.

II- Arrange the students in descending order according to the total scores of the test.

III- Dividing female students into two equal categories, an upper category containing the highest grades, and a lower category containing the lowest grades, and each category consists of (18) students.

IV- Calculate the number of correct answers for each test paragraph in both categories.

The following equation was then used to calculate the discrimination coefficient for each test item separately:

$$\text{Discrimination Coefficient} = \frac{\text{Number of correct answers in the top category} - \text{Number of correct answers in the lower category}}{\text{Number of female students in one category}}$$

The discrimination coefficients for the vocabulary of the mathematical concepts test ranged between (2.0 – 6.0) Table (4-5), so that the paragraphs with a discrimination coefficient between (2.0 – 39.0) are acceptable, and from (4.0) and more are considered good coefficients. (Abdulrahman, 2011), so the mathematical concept test items have the ability to distinguish between levels.

Table (4-5) Coefficients of difficulty and coefficient of discrimination for testing mathematical concepts

Question number	Coefficient of difficulty	Coefficient of Excellence	Question number	Coefficient of difficulty	Coefficient of Excellence
Q1	47.	39.	Q19	44.	33.
Q2	36.	21.	Q20	56.	20.
Q3	44.	44.	Q21	36.	21.
Q4	44.	44.	Q22	61.	44.
Q5	47.	61.	Q23	61.	33.
Q6	67.	44.	Q24	33.	44.
Q7	25.	39.	Q25	31.	28.
Q8	25.	39.	Q26	44.	33.
Q9	25.	39.	Q27	56.	33.
Q10	47.	61.	Q28	44.	33.
Q11	25.	39.	Q29	58.	21.
Q12	44.	44.	Q30	31.	28.
Q13	44.	56.	Q31	33.	44.
Q14	53.	39.	Q32	47.	61.
Q15	33.	44.	Q33	61.	44.
Q16	22.	33.	Q34	61.	20.
Q17	31.	28.	Q35	56.	22.
Q18	44.	33.			

Internal consistency of the test: Pearson's correlation coefficient was calculated between the score of each question and the total score of the test, as well as the Pearson correlation coefficient was calculated between the total scores of each level and the total number of test items, and the following table (4-6) shows the correlation coefficients between each paragraph of the test and the total number of test items.

Table (4-6) Pearson's correlation coefficients between each test item with the total number of test items

The validity of the internal consistency of the mathematical concept test phrases for the dimension (remembering):							
M	Correlation coefficient	Significance level	Total	M	Correlation coefficient	Significance level	Total
1	**708.	.000	D at 0.01	4	**537.	001.	D at 0.01
2	**605.	.000	D at 0.01	5	**595.	000.	D at 0.01
3	**579.	.000	D at 0.01				
The validity of the internal consistency of the statements of testing mathematical concepts of dimension (comprehension):							
M	Correlation coefficient	Significance level	Total	M	Correlation coefficient	Significance level	Total
6	**579.	.000	D at 0.01	14	**463.	004.	D at 0.01
7	**583.	.000	D at 0.01	15	**557.	000.	D at 0.01
8	**723.	.000	D at 0.01	16	*357.	032.	D at 0.01
9	**579.	.000	D at 0.01	17	*357.	032.	D at 0.01
10	**723.	.000	D at 0.01	18	**557.	000.	D at 0.01
11	*353.	.035	D at 0.01	19	*411.	013.	D at 0.01
12	**625.	.000	D at 0.01	20	**557.	000.	D at 0.01
13	**685.	.000	D at 0.01	21	**685.	000.	D at 0.01

Validity of the internal consistency of the mathematical concepts test statements for dimension (application):							
M	Correlation coefficient	Significance level	Total	M	Correlation coefficient	Significance level	Total
22	*350.	036.	D at 0.05	29	*406.	014.	D at 0.05
23	**503.	001.	D at 0.01	30	**727.	000.	D at 0.01
24	**637.	000.	D at 0.01	31	*377.	023.	D at 0.05
25	**487.	003.	D at 0.01	32	**727.	000.	D at 0.01
26	**727.	000.	D at 0.01	33	*374.	024.	D at 0.05
27	*332.	048.	D at 0.05	34	*408.	013.	D at 0.05
28	**470.	004.	D at 0.01	35	*361.	031.	D at 0.05

From Table (4-6), it is clear that all the values of the correlation coefficients between each test item in the total number of test items were very large, and all of them are statistically significant values at the significance level (0.05) and the significance level (0.01), which indicates that the test enjoys a high degree of acceptance.

Table (4-7) shows the correlation coefficients of the levels of mathematical concepts test with the grand sum

Table (4-7) Correlation coefficient between the total scores of each level and the total number of test items

Phrases	Correlation coefficient	Significance level	Total
Remember	**648.0	000,	D at 01.0
Understanding	**914.0	000,	D For 01.0
Application	**788.0	000,	D at 01.0

It is clear from Table (4-7) that all levels of mathematical concept testing have a positive and statistically significant correlation at the significance level (0.01) with the grand total. Thus, it is clear that all levels of the instrument measure what they were developed to measure.

– Test stability: Cronbach alpha stability coefficient was calculated to test mathematical concepts and levels as in the following table:

Table (4-8) Cronbach alpha stability coefficient for mathematical concept test levels

Question number	Coefficient of difficulty	Coefficient of Excellence	Question number	Coefficient of difficulty	Coefficient of Excellence
Q1	53.	61.	Q8	44.	56.
Q2	56.	44.	Q9	53.	39.
Q3	53.	39.	Q10	47.	39.
Q4	56.	44.	Q11	53.	61.
Q5	44.	56.	Q12	50.	33.
Q6	50.	44.	Q13	39.	44.
Q7	47.	50.	Q14	56.	56.

It is clear from Table (4-8) that the stability coefficients of the mathematical concepts test ranged between (0.56-0.84), and at the overall level, the stability coefficient was (0.87), which is a high value, which indicates that the test has a high degree of stability.

Second: Mathematical thinking skills test for first-grade intermediate students

The mathematical thinking skills test included in the mathematics course for the first intermediate grade for the academic year 1443 AH-1444 AH was prepared and applied before to the experimental and control groups, and then after applying the teaching method using the (K.W.L.H) strategy on the experimental and control groups in the usual way, and this test was prepared as follows:

1. Determine the objective of the test: The aim of the test is to reveal the level of first-grade students in the mathematical thinking variable as a learning outcome to use the (K.W.L.H) strategy in teaching.

2. Preparation of the specification table for the test: After reviewing the mathematics curriculum document (2019) and determining the mathematical thinking skills, the Study was limited to a set of skills suitable for the content of the "Algebra and Functions" unit of the mathematics course for the first intermediate grade of the first semester, and a table (4-9) of the specifications for testing mathematical thinking skills was built according to it and designed as follows:

Table (4-9) Specifications of the Mathematical Thinking Skills Test

Figure	Mathematical thinking skills	Number of questions	Total Scores	Relative weight of skill
1	Introspective	2	2	14.3%
2	Circular	2	2	14.3%
3	Conclusion	2	2	14.3%
4	Expression with symbols	2	2	14.3%
5	Modeling	2	2	14.3%
6	Reasoning and causation	2	2	14.3%
7	Criticism and evaluation	2	2	14.3%
Total		14	14	100%

3. Preparation of the initial image of the test: The test was designed from the type of multiple choice, and it consists of (14) questions, and the test relied on the following skills: (induction, generalization, conclusion, expression with symbols, modeling, reasoning and causality, criticism and evaluation) from the first unit "Algebra and Functions" of the mathematics course for the first intermediate grade - first semester 1443 AH-1444 AH.

4. Determining the validity of the test: To ensure the validity of the test, its initial image was presented to the scientific supervisor of the Study, and then presented to a group of arbitrators specialized in curricula and teaching methods in mathematics, and mathematics supervisors and teachers for the intermediate stage, Appendix (2), to benefit from their opinions and observations on the appropriateness of the test for the Study sample, and that it measures what was set to measure, and the soundness of the scientific and linguistic accuracy of the test questions, and correcting and amending what was agreed upon by the arbitrators.

Based on the agreed observations, some paragraphs of the test were amended according to the suggestions and recommendations of the arbitrators through the following:

1. Some mathematical thinking skills have been modified as suggested.

2. The tool has been linguistically reviewed, modified and formatted according to the notes.

3. Formulate the test instructions well with an example of the solution method.

4. Rephrase some questions, such as (3,6,8).

5. Consider alternatives to some questions, such as (1,3,7).

The final test became applicable to the sample Appendix 6.

5. Test correction: The test is corrected by giving one score for each question in the test if the correct answer is chosen, and giving a score of "zero" if the wrong answer is chosen in the question, and then the total score of the test is (14) points.

6. Formulation of test instructions: The instructions were written on the first sheet of the test, which included clarifying the purpose of the test, describing the test vocabulary in terms of the number of questions and alternatives, explaining how to answer multiple choice questions in the answer sheet of the test, and providing an example that illustrates this.

7. Exploratory experiment for the test: The test was applied to the sampleconsisting of (36) female students of the second intermediate grade in another school, in order to determine the following:

- The appropriate time for the test: The appropriate time was calculated to apply the test to the basic sample after re-applying the test to the exploratory sample in the Study, by recording the time taken by the first student who finished the test, which was estimated at (30) minutes, and recording the time taken by the last student who finished the test, which was estimated at (40) minutes, and by calculating the average time for them, the result showed that the appropriate time to apply the test is (35) minutes.

- Difficulty coefficients for test items: The difficulty coefficients for each of the test questions, which are to some extent acceptable, were calculated in Table (4-10), so that the difficulty coefficients ranged between (4.0-5.0), considering that the acceptable ranges between zero and one (Abdulrahman, 2011).

- Discrimination coefficient for test items: To calculate the discrimination coefficient for the paragraphs of the mathematical thinking skills test, the following steps were followed:

I- Correct the answers of the students of the survey sample to each question, and then record the final grade for each student.

II- Arrange the students in descending order according to the total scores of the test.

III- Dividing female students into two equal categories, an upper category containing the highest grades, and a lower category containing the lowest grades, and each category consists of (18) students.

IV- Calculate the number of correct answers for each test paragraph in both categories.

The following equation was then used to calculate the discrimination coefficient for each test item separately:

Discrimination Coefficient =

$$\frac{\text{Number of correct answers in the top category} - \text{Number of correct answers in the lower category}}{\text{Number of female students in one category}}$$

The discrimination coefficients for the vocabulary of the mathematical thinking skills test ranged between (3.0 - 6.0), table (4-10), so that the paragraphs with a discrimination coefficient between (2.0 – 39.0) are acceptable, and from (4.0) and more are considered good coefficients (Abdul Rahman, 2011), and thus the paragraphs of the mathematical thinking skills test have the ability to distinguish between levels.

Table (4-10): Coefficients of difficulty and discrimination coefficient for testing mathematical thinking skills

Question number	Coefficient of difficulty	Coefficient of Excellence	Question number	Coefficient of difficulty	Coefficient of Excellence
Q1	53.	61.	Q8	44.	56.
Q2	56.	44.	Q9	53.	39.
Q3	53.	39.	Q10	47.	39.
Q4	56.	44.	Q11	53.	61.
Q5	44.	56.	Q12	50.	33.
Q6	50.	44.	Q13	39.	44.
Q7	47.	50.	Q14	56.	56.

– Internal consistency of the test: Honesty of the internal consistency of the paragraphs of the mathematical thinking skills test:

Table (4-11) shows the correlation coefficients between each item of the mathematical thinking skills test and the overall score.

Table (4-11) Correlation coefficient between each paragraph of the mathematical thinking skills test with the total

M	Correlation coefficient	Significance level	Total	M	Correlation coefficient	Significance level	Total
1	**654.	000.	D at 0.01	8	**613.	000.	D at 0.01
2	*388.	019.	D at 0.05	9	**535.	001.	D at 0.01
3	**535.	001.	D at 0.01	10	**461.	005.	D at 0.01
4	*359.	032.	D at 0.05	11	**654.	000.	D at 0.01
5	**613.	000.	D at 0.01	12	*386.	020.	D at 0.05
6	**549.	001.	D at 0.01	13	**670.	000.	D at 0.01
7	**580.	000.	D at 0.01	14	**523.	001.	D at 0.01

From Table (4-11), it is clear that all the values of the correlation coefficients between each test item and the total number of test items were very large, and all of them are statistically significant values at the significance level (0.05) and the significance level (0.01), and this indicates that all

statements are related to the total score and thus the test is considered true to what was set to measure.

Table (4-12) shows the correlation coefficients of the dimensions of the mathematical thinking skills test with the grand sum

Table (4-12) Correlation coefficient of the dimensions of the mathematical thinking skills test axis with the grand total

M	Phrases	Correlation coefficient	Significance level	Total
1	Introspective	**720.	000.	D at 0.01
2	Circular	**696.	000.	D at 0.01
3	Conclusion	**683.	000.	D at 0.01
4	Expression with symbols	**823.	000.	D at 0.01
5	Modeling	**667.	000.	D at 0.01
6	Reasoning and causation	**716.	000.	D at 0.01
7	Criticism and evaluation	**789.	000.	D at 0.01

It is clear from Table (4-12) that all dimensions of the mathematical thinking skills test axis have a positive and statistically significant correlation at the significance level (0.01) with the total sum of the axis to which they belong. Thus, it is clear that all dimensions of the instrument measure what it was designed to measure.

– Stability of the test: The Cronbach alpha stability coefficient was calculated to test mathematical thinking skills and estimated at (787.0), which is a high value, which indicates that the test is an acceptable degree of stability, and then the mathematical thinking skills test became applicable to the basic sample and can be relied upon to obtain accurate results that serve to achieve the Study objectives.

Application of search tools:

The basic Study experiment was carried out based on the following:

1. The Studyer taught the first unit "Algebra and Functions" of the mathematics course for the first intermediate grade using the strategy (K.W.L.H) after the approval of the Education Department of the Asir region for the students of the experimental group, in order to ensure the validity of the results and the lack of sufficient time to train the basic teacher due to the application at the beginning of the year and reduce the burden on her, and the teaching was carried out in the usual way by the basic teacher for the students of the control group from 1/2/1444 AH to 23/2/1444 AH.

2. Applying the mathematical concepts test and the mathematical thinking skills test dimensionally on the experimental and control samples, in order to reveal the effectiveness of using the (K.W.L.H) strategy in improving the level of experimental group students from the control group in acquiring mathematical concepts and developing mathematical thinking skills on 22-23/2/1444 AH.

3. Correct tests and monitor results to process them statistically.

5. Results

Results of the first statistical hypothesis test:

The text of the first Study question on: What is the effectiveness of using the (K.W.L.H) strategy in acquiring mathematical concepts among first-grade intermediate students?, and the first Study was imposed as follows:

The first hypothesis: There are no statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical concept acquisition test in favor of the experimental group.

To test this hypothesis, the t-test was used for two independent samples and the calculation of arithmetic averages and standard deviations, and the results of Table (5-1) illustrate this.

Table (5-1) Arithmetic Averages, Standard Deviations and Test (T) for Two Independent Samples in the Mathematical Concepts Test

Mathematical concepts	Number of concepts	Number of questions	Experimental Group (34) Students		Control group (34) students		Value (t)	Significance level	Total
			Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Remember	5	5	41.2	076.1	68.1	121.1	614.7	007,	function
Understanding	11	16	38.7	764.2	41.5	760.1	SR299.12	001,	function
Application	10	14	88.4	935.1	41.3	480.1	SR395.12	001,	function
Total	26	35	89.4	574.1	50.3	933.0	690.19	000,	function

It is clear from Table (5-1) that the differences between the averages of the scores of the students of the experimental and control groups in the dimensional application of the mathematical concepts test are statistically significant at the level of significance (0.05) in favor of the experimental group with the highest average, and in light of this result, the first hypothesis of the Study can be rejected, which stipulated that there are no statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the test of acquiring mathematical concepts in favor of the experimental group, and accepting the alternative hypothesis that states There are statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical concept acquisition test, in favor of the experimental group.

Size of the Event:

To calculate the size of the effectiveness of applying the strategy (K.W.L.H) on the first dependent variable (mathematical concepts), the Eta square scale (Eta square) η2 was used, and the results were as follows in Table (5-2):

Table (5-2): ETA square values (η2) for the test levels of mathematical concepts and the magnitude of effectiveness for each.

Level	Value(η2(When are you square?	Size of the effectiveness	Order
Remember	630.0	High	Third
Understanding	816.0	High	Second
Application	819.0	High	The first
Overall Test	919.0	High	
Effectiveness is low when = 01.0, effectiveness is medium when = 06.0, effectiveness is high when = 16.0 (Murad, 2011)			

It is clear from the values of Table (5-2) that the values of (η2) are high in the size of the effectiveness of the independent variable (K.W.L.H) strategy on the first dependent variable (mathematical concepts);

The results of the second statistical hypothesis test:

The text of the second Study question on: What is the effectiveness of using the (K.W.L.H) strategy in developing mathematical thinking skills among first-grade intermediate students?, The second Study was imposed as follows:

The second hypothesis: There are no statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical thinking skills development test for the benefit of the experimental group.

To test this hypothesis, the t-test was used for two independent samples and the calculation of arithmetic averages and standard deviations, and the results of Table (5-3) illustrate this.

Table (5-3) Arithmetic Averages, Standard Deviations and Test (T) for Two Independent Samples in the Mathematical Thinking Skills Development Test.

Mathematical thinking skills	Number of questions	Experimental Group (34) Students		Control group (34) Students		Value (t)	Significance level	Total
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation			
Introspective	2	91.0	452.0	53.0	563,	533.9	003,	function
Circular	2	21.1	592.0	71.0	799,	600.8	005,	function
Conclusion	2	09.1 SR	570.0	68.0	684.0	267.7	009,	function
Expression with symbols	2	SR29.1	524.0	82.0	716.0	557.9	003,	function
Modeling	2	03.1	627.0	65.0	544.0	215.7	009,	function
Reasoning and causation	2	82.0	521.0	35.0	597.0	SR 000.12	001,	function
Criticism and evaluation	2	09.1 SR	621.0	50.0	663.0	SR255.14	000,	function
Overall Test	14	06.1 SR	259.0	61.0	236.0	SR 093.58	000,	function

It is clear from Table (5-3) that the differences between the averages of the scores of the students of the experimental and control groups in the dimensional application of the mathematical thinking skills test are statistically significant at the level of significance (0.05) in favor of the experimental group with the highest average, and in light of this result, the first hypothesis of the

Study can be rejected, which stipulated that there are no statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical thinking skills test, and the acceptance of the alternative hypothesis that states that there are Statistically significant differences at the level of (0.05) between the average scores of the experimental group students and the control group students in the mathematical thinking skills test, in favor of the experimental group.

Size of the Event:

To calculate the size of the effectiveness strategy (K.W.L.H) in the second dependent variable (mathematical thinking skills), the ETA square scale (η2) was used, and the results were as in Table (5-4):

Table (5-4) ETA square values (η2) for mathematical thinking skills test levels and the size of effectiveness for each.

Level	Value(η2(When are you square?	Size of the effectiveness	Order
Introspective	728.0	High	Fourth
Circular	685.0	High	V
Conclusion	608.0	High	Sixth
Expression with symbols	729.0	High	Third
Modeling	605.0	High	Seventh
Reasoning and causation	809.0	High	Second
Criticism and evaluation	857.0	High	The first
Overall Test	990.0	High	
Effectiveness is low when = 01.0, effectiveness is medium when = 06.0, effectiveness is high when = 16.0 (Murad, 2011)			

It is clear from the values of Table (5-4) that the values of (η2) are high in the size of the effectiveness of the independent variable (K.W.L.H) strategy on the second dependent variable (mathematical thinking skills), and the effectiveness was very high.

View results related to study questions

The Study questions are as follows:

1. What is the effectiveness of using the K.W.L.H strategy for teaching mathematics in acquiring mathematical concepts among first-grade intermediate students?

2. What is the effectiveness of using the K.W.L.H strategy for teaching mathematics in developing mathematical thinking skills among first-grade intermediate students?

Through the above in presenting the results of the first and second questions of the Study, it can be said: The strategy (K.W.L.H) is highly effective in acquiring mathematical concepts among first-grade intermediate students in the "Algebra and Functions" unit for the first semester of the mathematics course, and the results of the application of the strategy (K.W.L.H) are highly effective in developing mathematical thinking skills, so it can be said: The effectiveness of using the (K.W.L.H) strategy) to teach mathematics high in the acquisition of mathematical concepts and the development of mathematical thinking skills among first-grade intermediate students.

Second: Discuss and interpret the results of the Study

First: Acquisition of mathematical concepts

The results of the Study found to verify the effectiveness of using the (K.W.L.H) strategy for teaching mathematics in acquiring mathematical concepts among first-grade intermediate students, where statistically significant differences were found at the level of (05.0) between the average scores of the students of the experimental and control groups in the post-application of the mathematical concepts test, and this result is consistent with my studies (Al-Enezi, 2019; Ali, 2019).

The steps of this strategy contributed to identifying previous mathematical concepts and worked to activate them and correct the wrong ones, by filling in the columns of the table, the organization between the old concept and the identification of the new concept and linking them to integrate knowledge in the student's mind, so it became easy to acquire mathematical concepts in an organized and clear manner, as this strategy depends on the student in a large and specific way, and is limited The teacher's task is to guide and guide during the presentation of the lesson, and the strategy was characterized by being diversifiable between the methods of education (individual / group), in the individual method to develop the student's ability to self-learning by identifying previous concepts, distinguishing new concepts and knowing the links between them, while in the group learning method, it allows social interaction during the exchange of knowledge and experiences, discussing and recording them in the strategy table so that learning becomes organized and coherent, and the strategy table is characterized by ease of dealing with it and recording in its columns, The strategy table can also be used during the solution of exercises and mathematical problems, by identifying the previous concept (data) in the problem, defining the new concept (required) in the problem, then recording what he learned (solving the problem) through Study, recording and discussing the results, and in the last stage (confirmation) further by applying the concept to new educational issues and situations.

Second: Developing mathematical thinking skills

The Study found the effectiveness of using the (K.W.L.H) strategy for teaching mathematics in developing mathematical thinking skills among first-grade intermediate students, as it was found that there were statistically significant differences at the level of (05.0) between the average scores of the students of the experimental and control groups in the post-application of the mathematical thinking skills test, and this result is consistent with the study of Al-Qawasmi et al. (2020), which confirmed the effectiveness of the (K.W.L.) strategy in teaching mathematical thinking.

The (K.W.L.H) strategy has greatly helped in developing the mathematical thinking skills of first-grade intermediate students in the Algebra and Functions Unit, through the acquisition of knowledge and its organization in a table that develops other skills in mathematics, so the strategy allowed to organize and clarify the interdependence between mathematical concepts and enhance mathematical thinking skills during application, and this led to increasing the effectiveness of the (K.W.L.H) strategy) In the development of mathematical thinking skills, the strategy has contributed to enabling communication between students through group learning by subtracting, discussing and recording knowledge and experiences in the table columns to help

organize and refer to them when needed, and also allowed their use in solving mathematical problems and applying them in educational situations that require basic mathematical skills, and when using the (K.W.L.H) strategy) in the mathematical problem and the inclusion of mathematical thinking skills in it, the strategy works to recall the required skills and activate them in order to solve the problem. With the repetition of the process and the activation of the principle of self-learning, these skills develop with the learner's cognitive reality of the skill involved in mathematical problems.

6. Study recommendations

In light of the results of the Study, the Study recommends the following:

1. Directing those interested in the field of curriculum and teaching methods to benefit from the K.W.L.H. strategy in the field of mathematics teaching and learning.

2. Holding training courses that encourage teachers to use the K.W.L.H. strategy in teaching mathematics.

3. Training students to use the K.W.L.H strategy in topics that contain a large number of mathematical concepts and that are related to previous mathematical concepts.

4. Attention to the development of mathematical thinking skills for middle school students, and focus on basic skills that in turn support higher thinking skills.

5. Preparing and adjusting the classroom to take advantage of all the time allotted to it, and to be able to use the stages of the strategy and discuss them during the lesson.

6. Diversify the study style when using the K.W.L.H strategy to promote both self-learning and group learning, which has an effective impact on increasing academic achievement.

Study Proposals

The Study suggests conducting future Study in the following:

1. Conducting studies using the K.W.L.H strategy in teaching mathematics, and focusing on study units that contain a large number of interrelated mathematical concepts to determine the impact of the effectiveness of the strategy.

2. Compare the effectiveness of using the K.W.L.H strategy in teaching mathematics with other strategies.

3. Measuring the reality of teachers in diversifying teaching methods and strategies in mathematics for the intermediate stage.

4. Evaluating the reality of middle school students in the level of mathematical concepts and mathematical thinking skills.

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