

## The effectiveness of a proposed strategy according to the Fraunhofer model of knowledge management in the achievement of second intermediate female students in mathematics

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**Abstract:** The goal of the research is to identify the effectiveness of using a proposed strategy according to the Fraunhofer model of knowledge management in mathematics achievement for second-grade female students in middle and high schools affiliated with the General Directorate of Education in Baghdad / Al-Karkh II. The objective was to prove the following null hypothesis: "The average scores of the experimental group who will study with the proposed strategy according to the Fraunhofer model and the scores of the control group students who will study in the usual way in the mathematics achievement test are not statistically significant different at the significance level (0.05)." The General Directorate of Education of Baghdad / Al-Karkh II identified the research population, which represents middle and secondary schools for girls. Sayyida Zainab (peace be upon her) middle school was specifically selected as the research sample, which was divided into two groups and included sixty-one female students in the second middle grade. For the experimental group, represented by Section (A), there were thirty-three female students; for the control group, represented by Section (C), there were twenty-eight female students. Achievement test was developed to gather data for the study. Its final form included 36 objective items of the multiple choice type with four alternatives. Parity was carried out statistically between the female students of the experimental and control groups in the variables (previous achievement in mathematics, previous mathematical knowledge, intelligence). Appropriate statistical techniques were applied when administering the test to the female students in the experimental and control groups (difficulty and ease coefficient, discrimination coefficient, efficacy of alternatives). After the two researchers applied suitable statistical techniques to analyze the data and administer a test like the Leaven's test, the results showed that teaching with the suggested strategy according to the Fraunhofer model of knowledge management has a significant impact in improving the achievement of the female students of the experimental group compared to the control group. Its psychometric properties were acknowledged.

**Keywords:** Achievement, Fraunhofer model of knowledge management, Proposed strategy.

### 1. Introduction

Raising the level of achievement among pupils is one of the main issues and challenges facing the educational institution, and this is one of the issues that has intrigued those in this sector. [1] Students perform poorly in a number of courses, mathematics foremost.[2] He still has to deal with a number of issues while instructing mathematics; some of these have to do with the subject's essence, its organizational structures, and its scope.[3] Furthermore, a lack of interest in mathematics and a lack of motivation to study it may be the result of most teaching strategies that merely make students bored and monotonous, which prevents them from effectively handling numbers and operations on them.[4] As such, it was imperative to look for teaching methods that would improve student performance and

lessen the challenges of the academic material. One of the fundamental ways to gauge how well the educational process is going is to find out how well pupils are really doing in math.

### 1.1. *Research Question*

Considering the aforementioned, the two researchers can define the research issue as follows: (What is the effectiveness of a proposed strategy based on the Fraunhofer model on mathematics achievement for second-year intermediate female students?)

### 1.2. *The Importance of Research*

Knowledge management enables the requisite adaptability in work, facilitating its utilization in problem-solving, decision-making, and drawing insights from past encounters.

This research aims to facilitate the familiarity of male and female teachers with diverse mathematical methodologies. It assists the individuals responsible for the preparation and training department by using techniques, approaches, and tactics that enhance the advancement of mathematics instruction for instructors. It offers mathematics teachers an established methodology for teaching mathematics, which has the potential to enhance the academic performance of female students.

### 1.3. *The Aims of Research*

The current research aims to determine the effectiveness of a proposed strategy according to the Fraunhofer model of knowledge management in mathematics achievement for second-year intermediate school female students.

### 1.4. *Hypotheses of Research*

In order to achieve the study aim, the following null hypothesis was developed:

The average scores of the female students in the experimental group studying with the suggested strategy according to the Fraunhofer model and the scores of the female students in the control group studying in the traditional manner in the mathematics achievement test are not statistically significant different at the significance level (0.05).

### 1.5. *Limits of Research*

The search is determined as follows:

- 1-female students enrolled in middle and secondary day schools in Baghdad / Al-Karkh II who are in the second intermediate grade for the academic year 2023–2024.
2. The fourth chapter (real numbers, terms, equations, and inequalities) of the mathematics textbook recommended by the Iraqi Ministry of Education for the second intermediate grade, fifth edition, 2023, Jassim et al.

### 1.6. *Definitions of the Terms*

#### 1.6.1. *Effectiveness*

The influence of an independent variable on one of the dependent variables that experimental treatment can have [5]. The two researchers define it procedurally as: - The effect that using a proposed strategy in accordance with the Fraunhofer model of knowledge management when teaching mathematics classes (rational numbers, real numbers, limits, equations, and inequalities) scheduled for the second intermediate grade has on the achievement of female students in the second intermediate grade from the research sample in mathematics. This is implied. It is calculated using the difference between the experimental and control groups' average post-test scores for each achievement.

### 1.6.2. Strategy

A set of procedures and techniques that the teacher uses in the classroom to achieve the outcomes he has established. It consists of a collection of methods, means, activities, and evaluation techniques that aid in the achievement of the objectives. [6].

The researchers define it procedurally as the comprehensive set of steps, procedures, and capabilities that will be meticulously followed during the classroom experiment. The purpose of this framework is to successfully achieve the lesson objectives and attain the desired outcomes. The framework is designed to ensure that the students participating in the experiment are able to comprehend and grasp the lesson content. It encompasses a variety of educational tools and techniques. This contributes to the school's attainment of its established objectives.

### 1.6.3. Knowledge Management

Knowledge management is the systematic process of acquiring, storing, sharing, creating, and utilizing knowledge in various interrelated formats to enhance learning, foster creativity, improve performance, and facilitate decision-making. [7].

The two researchers define it procedurally as a collection of systematic procedures that encompass the identification, creation, and retention of information, followed by its practical implementation. The proposed strategy, based on the Fraunhofer model of knowledge management, is used to teach female students in the second intermediate grade from the research sample. This strategy includes educational activities specifically designed to assist the female students in the experimental group. When building and acquiring knowledge.

### 1.6.4. Fraunhofer Model

The model is grounded in the implementation of knowledge processes and posits that knowledge management encompasses the techniques and resources that facilitate the improvement of its fundamental processes. These processes, as identified by the model, include defining knowledge objectives, diagnosing knowledge, generating knowledge, storing knowledge, distributing knowledge, and applying knowledge. [8].

The two researchers define it procedurally as: "A model that conceptualizes knowledge management as a strategic approach encompassing six sequential steps that involve transferring knowledge to the student. These steps include defining knowledge objectives, diagnosing knowledge, generating knowledge, storing knowledge, distributing knowledge, and applying knowledge."

### 1.6.5. Achievement

An individual's academic performance level is determined by evaluating their answers to theoretical, practical, or oral achievement tests at the end of the academic year. This evaluation is based on the student's cognitive mental activity and can also be done using standardized achievement tests. [9]

The researchers define it procedurally as the outcome of the knowledge, information, and experiences gained by second-year middle school students from the research sample after studying specific mathematics topics (rational numbers, real numbers, limits, equations, and inequalities) as prescribed. It is measured by the total score obtained by the student in the achievement test designed for this purpose. The objective.

## 2. Theoretical Background

### 2.1. Fraunhofer Model of Knowledge Management

This model is grounded in the practice of operations, assuming that knowledge management encompasses the tools and procedures that enhance its fundamental operations. The model specifies six distinct processes:

1 - Establish knowledge objectives: Knowledge goals are defined as a means to accomplish the institution's cognitive objectives. In accordance with these specific cognitive objectives, various

strategies are employed for other cognitive activities, including generation, storage, dissemination, and application.

2- Assessment of knowledge: The purpose of this assessment is to evaluate the learner's knowledge, which is essential for them to stay competitive with their peers. It enables the learner to acquire in-depth knowledge through training, teaching, and drawing from their previous experiences or attending lectures.

3 - Knowledge generation: This refers to the process of developing new knowledge by involving learners in supporting its development. It facilitates problem-solving and solution-finding through inventive means, hence emphasizing the reciprocal nature of knowledge and creativity. Knowledge serves as a catalyst for innovation, while innovation in turn serves as a catalyst for generating new knowledge.

4- Knowledge storage: This refers to the act of storing knowledge, including retention, perpetuation, study, and retrieval. Furthermore, it highlights the significance of organizational memory, as knowledge is preserved through the exchange of knowledge and experiences among individuals.

5 – Knowledge dissemination: This refers to the process of spreading knowledge and facilitating decision-making in an engaging manner, as it enables individuals to share knowledge, ideas, and strategies and effectively communicate them to others.

Application of knowledge refers to the process of utilizing knowledge effectively to attain excellence and innovation. It is crucial for the success of any endeavor, since all preceding stages become futile without the efficient application of knowledge. [10].

Based on this model, the two researchers put up a pedagogical approach. The steps of the suggested method, as per the Franhofer \ model, encompass the following: The user did not provide any text.

The initial stage involves the process of assessing and identifying one's level of understanding and expertise.

The next phase involves identifying the goals or aims of knowledge. The third stage involves the process of establishing connections between ideas and creating new knowledge.

Step Four: Preserve knowledge

Step 5: Expansion

Establishing connections between concepts and producing new knowledge: It refers to the act of seeking for the attributes of unrelated goods. The combination of existing elements, when they are disassembled and reassembled, results in a composite entity that possesses a higher worth than a mere collection of individual components. Therefore, the connection between concepts and information results in the creation of novel knowledge.

Expansion refers to thoroughly discussing a topic by exploring many perspectives and gathering comprehensive knowledge to uncover all its details. [11] & [12]

Based on the Fraunhofer model of knowledge management, the two researchers developed a strategy for teaching mathematics that is tailored to the needs of female students in the second Intermediate academic stage. They believe that by adding additional steps to the original model, they can create an environment that encourages female students to actively participate in exchanging information, knowledge, and experiences. This strategy aims to provide female students with the opportunity to present ideas and contribute to solving specific mathematical problems. These tactics promote collaboration and foster a culture of mutual respect among female students, with an emphasis on placing the female student at the center of the educational process.

## 2. 2. Achievement

### 2. 2.1. Achievement Concept

Various scholars and specialist researchers have presented the concept of achievement in different ways, with the most notable approach being the one that associates it with academic learning in schools. The grade that pupils receive reflects the amount of accomplishment they have attained. Which is sanctioned by the school within a specific timeframe of education.[13]

The student places significant value on academic performance, since it serves as a pathway to self-actualization and the acquisition of a certificate. By attaining success, it becomes possible to identify the challenges that learners are encountering. Academic achievement serves as a measure of learners' abilities and accomplishments, and it is an indicator of the effectiveness of the educational system.[14]

### 2.2.2. Factors that Influence Achievement

Research, literature, and prior research indicate numerous elements and causes that influence academic achievement. The factors can be categorized into two primary components:

A) Educational aspects: refer to the elements associated with the process of education, encompassing factors connected to:

1- The academic subject: These elements encompass the level of complexity of the subject matter, its structural organization, and the degree to which it relates to the learners' life.

2- The teacher: These elements encompass the instructional tactics, techniques, and approaches employed by the teacher, the tasks and exercises assigned, the degree to which individual learner differences are considered, as well as the teacher's demeanor within the classroom.

At the school, several elements contribute to its overall quality. These factors encompass the school's administration and its competence, the dimensions of the classrooms, and the level of resources available such as books, educational materials, and extracurricular activities.

B) Personal aspects: These factors pertain to the student, their family, and the characteristics of the society they are a part of. They are denoted by the variables:

1- Psychological and health: This category encompasses the learner's physical and mental well-being, their cognitive capabilities, self-assurance, and their drive to acquire knowledge.

2- Social: encompasses the socioeconomic standing of the family as well as the nature of interpersonal connections within the family unit.[15].

## 3. Research Methodology

The researchers utilized the experimental method to accomplish the research goals. It is characterized by employing experimentation as a means to verify the accuracy of theories.

### 3.1. Research Population

Female students in the second grade who went to middle and secondary day schools in Baghdad that were part of the General Directorate of Education of Baghdad, Al-Karkh II, for the 2023–2024 school year made up the current study population.

### 3.2. Research Sample

There were a total of 61 female students included in the sample for this study, with 33 female students assigned to the experimental group and 28 female students to the control group.

### 3.3. Research Tool

In order to find out if the research goals and hypotheses were fulfilled, a test was developed to assess the dependent variable, which stands for achievement. The following procedures were used in the construction of the test: - must ascertain the purpose of the examination. The objective of the test is to assess the mathematical proficiency of the two groups of female students in their second year of intermediate study.

Deciding on the field of study: For the academic year (2023–2024), the scientific topic content was derived from the mathematics textbook for the second intermediate grade, namely the fifth edition (updated).

Developing the Behavioral Objectives: The scientific literature was analyzed to develop the behavioral objectives. In light of the arbitrators' views on mathematics education strategies, the two academics settled on these goals.

Development of the Achievement Test Items: We used Bloom's six levels of knowledge to distribute 36 multiple-choice questions with four answers.

Presenting the test to the arbitrators: After reviewing it with a panel of experts in mathematics education, we made some revisions that resulted in 36 objective items, all of which were multiple-choice with four possible answers.

Using the test on the initial exploratory sample: data sample. An exploratory sample of the research community, distinct from the main sample, was subjected to the test. Among the most notable outcomes of this application's execution were the extraction of the time average and the clarification of a few unclear passages.

Re-applying the test to the second exploratory sample (Statistical analysis sample) Once the two researchers had established that the test would take an adequate amount of time and that the items were understandable, they could proceed to statistical analysis. Once the experiment's subject was finished, the exam was administered to a second exploratory sample of female students in the second intermediate year. A week prior to the test, the students were notified of when it will be given.

### *3.4. Analysing the Exam Items Statistically*

#### *3.4.1. The Paragraph's Difficulty*

Using a technique for determining the difficulty of objective items, we were able to determine the test items' difficulty factors, which were within an acceptable range of (0.25 - 0.42). [16]

#### *3.4.2. Coefficient Of Discrimination*

The objective achievement test items' discriminating coefficients, which were calculated using the above equation, varied between 0.25 and 0.53. From what was said, paragraphs can be considered a valid indication. [17]

#### *3.4.3. The Effectiveness of Wrong Alternatives*

Following the formula for the efficacy of the wrong alternatives, we discovered that, with the exception of the correct choice, the effectiveness of the wrong alternatives was negative for all thirty-six multiple-choice test items.

### *3.5. Check the Reliability and Validity of the Instrument*

#### *3.5.1. Issues of Virtual Validity*

To make sure the accomplishment test items seemed legitimate, the two researchers gave them to a panel of arbitrators who were well-versed in mathematics education and could offer their thoughts on the items' legitimacy. With the permission of the arbitrators, the items were deemed acceptable by a majority of the arbitrators, with a proportion of over 80%. The last round of exam questions included 36

#### *3.5.2. Stability*

The two researchers computed the stability of multiple-choice objective exam items using the special equation (Kuderchardson-20). According to [18], the achievement test has an acceptable reliability value of 0.77.

The last accomplishment test: The test was administered to the two study groups from the main sample after the items were statistically analyzed and the psychometric features were confirmed. The female students were given one week prior to the exam to ensure they were well prepared.

## **4. Results and Discussions**

### *4.1. Results*

In order to learn about the outcomes of the achievement test for second-year intermediate school students, we first checked if the first null hypothesis was true. We found that there wasn't a statistically significant difference (at the 0.05 level) between the average math test scores of the girls in the

experimental group who used the Fraunhofer model-recommended strategy and those in the control group who studied the traditional way.

A statistical description of the final data, for the control and experimental groups in the final achievement exam, was obtained using the statistical program (SPSS) version (23) and is shown in Table 1. Two researchers administered the test to the basic research sample.

**Table 1.**

The statistical description of the final data.

Group	Number	Mean score	Standard deviation	Standard deviation standard error	95 %confidence interval for the mean	
					Upper limit	Lower limit
Experimental	33	28.4848	5.4206	0.9436	8.7855	2.700
Control	28	22.8571	6.8999	1.3040	8.8592	2.3962

#### 4.2. Discussions

The scientific information was organized via the instructional phases according to the specified method, which made learning interesting for the students and helped them understand the main and secondary ideas leading up to it.

Students' efficiency in solving and handling problems and situations was enhanced as they learned to logically and properly organize mathematical information and ideas in order to reach the solution or the logical sequence of new concepts. This was made possible by their pursuit of the largest amount of ideas and information.

The recommended approach shifted the emphasis from the teacher to the student, who was then able to retain more of the material thanks to his increased agency in conducting his own study and arriving at his own conclusions. The method also views the teacher's duty as that of a guide and facilitator of learning.

### 5. Conclusions

Based on the research findings, the following conclusions can be drawn: The proposed strategy has a noticeable impact on improving the academic performance of female students in the experimental group in mathematics, compared to the female students in the control group who followed the traditional teaching method. The teaching procedures aligned with the proposed technique adhere to contemporary educational trends that prioritize students as the central focus of the educational process and employ cooperative learning.

### 6. Recommendations

Based on the research findings, the researchers propose the following recommendations: I strongly recommend and motivate all mathematics teachers, regardless of gender, at every level of education, to implement the suggested technique based on the Fraunhofer model of knowledge management.

The research has the potential to provide mathematics teachers at all levels and educational supervisors with a clear understanding of how to effectively utilize a proposed method based on knowledge management models in the teaching of mathematics.

It is essential to incorporate new teaching tactics, such as the proposed strategy based on the Fraunhofer model of knowledge management, into the mathematics preparation curriculum for both male and female instructors in colleges of education.

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