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## Enhancing mathematics teachers' pedagogical skills by using ChatGPT

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### Abstract

The primary aim of this study was to propose a conceptual framework intended to leverage the capabilities of the Chat GPT artificial intelligence model to enhance the creative teaching proficiencies of secondary school mathematics teachers. A closed interview questionnaire designed by the researcher was administered to evaluate the proficiency levels of secondary mathematics teachers using a descriptive methodology. The study sample comprised 31 mathematics teachers. Furthermore, the researcher developed a proposed conceptual framework aimed at activating the Chat GPT model to foster creative teaching skills among secondary mathematics teachers. Analysis of the data revealed that teachers demonstrated a moderate level of proficiency in the planning dimension of creative teaching while their execution and evaluation competencies were comparatively less advanced. Moreover, the study confirmed the appropriateness of the proposed conceptual framework for augmenting the creative teaching aptitudes of secondary mathematics teachers emphasizing its relevance, significance and practical utility. According to teachers' perspectives, this framework is appropriate in light of its relevance, importance and applicability. In a nutshell, this research contributes to the discourse on innovative pedagogical strategies by proposing a viable framework for the integration of artificial intelligence technologies into mathematics education. By doing so, it seeks to nurture creativity and efficacy among teachers within the secondary school potentially enhancing the quality of mathematics instruction and student learning outcomes. These findings underscore the importance of integrating regenerative AI ChatGPT into classrooms emphasizing its role in enhancing creative teaching skills and its practical applicability in educational contexts.

**Keywords:** STEM science, Artificial intelligent, Creative teaching, Engineering, Generative AI (ChatGPT), Math, Pedagogical skills, Technology.

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## 1. Introduction

Education systems worldwide are undergoing a paradigm shift recognizing the critical importance of creativity in fostering meaningful learning experiences. Traditional teaching methods often struggle to engage students and cultivate essential skills within the realm of mathematics education. Artificial intelligence (AI) has emerged as a transformative tool replicating the cognitive abilities of the human mind. This paper explores the impact of AI particularly regenerative AI ChatGPT on education in Saudi Arabian secondary schools.

ChatGPT distinguishes itself among artificial intelligence solutions by providing not just information dissemination but also the ability to contribute to research introduced by OpenAI and released in 2022. ChatGPT impacts societal values through its widespread use extending beyond individual interactions using sophisticated deep learning methods. This study focuses on improving the pedagogical abilities of female math teachers in Saudi Arabian secondary schools aiming to empower teachers and improve educational outcomes. ChatGPT's adoption among teachers remains limited creating disparities in educational performance despite its potential. The paper advocates integrating ChatGPT into teacher training programs, aligning with Saudi Vision 2030's goal of incorporating AI and technology in education. Developing AI literacy among teachers is crucial involving curriculum analysis and employing Technological Pedagogical Content Knowledge (TPACK) for AI education in K-12 settings [1] highlights the high acceptance rate of artificial intelligence among teachers continuous teacher training as highlighted by previous research is essential to adapting to scientific and technological advancements and achieving educational objectives.

Furthermore, this paper stresses the importance of creative teaching skills in fostering an engaging learning environment. Creativity in education is pivotal for nurturing highly skilled and innovative students. Teachers equipped with creative teaching skills can actively engage students addressing teaching deficiencies and enhancing both cognitive and skill aspects of the curriculum. Teachers play a vital role in shaping students' competencies and fostering innovation by encouraging creative work and challenging students intellectually. This paper emphasizes the importance of these skills as integral to the knowledge-building process within the learning context as evidenced by studies conducted by [Bereczki and Karpati \[2\]](#), [Beaird et al. \[3\]](#) and [Huang et al. \[4\]](#). Creative teaching can develop the sensitivity of skilled students to learning and make learning active and interesting [5].

However, teachers often face many problems in applying creative teaching during the educational process those issues need to be resolved. Artificial intelligence contains many tools that are evolving at all times and that have proved to be effective in some educational situations. According to the results of studies that have indicated the effectiveness of chat robots based on artificial intelligence in the educational process and the development of teaching skills among teachers such as [Haque et al. \[6\]](#) & [Ullah et al. \[7\]](#). In a nutshell, enhancing the teaching skills of female math teachers in Saudi secondary schools is crucial for promoting gender equity in math education. Teachers can be empowered to provide high-quality math instruction and narrow the gender gap in math achievement by addressing factors such as gender disparities, math anxiety, and technology integration and leveraging AI-based instructional technology.

### 1.1. Research Problem

This research focuses on the integration of generative AI, ChatGPT as a potential solution to enhance the creative teaching skills of secondary school mathematics teachers. Teachers face significant challenges when it comes to the intricate process of curriculum planning, lesson delivery and pedagogical explanations. The complexities are further compounded by the necessity of tailoring these educational components to the specific age groups they are instructing while concurrently acknowledging the pronounced individual differences among their students and adhering to the constraints imposed by the school calendar. This quandary underscores a critical observation made by researchers. Vocational development programs designed to augment teaching competencies exhibit shortcomings in fostering the requisite skills for crafting pedagogically innovative and efficacious teaching strategies, a facet synonymous with creative teaching [8-10].

Since teachers are one of the pillars of the educational process, it is crucial to strengthen their role and improve their qualifications in creative teaching, monitor their progress, provide them with the necessary support, adjust their career paths and solve problems that hinder their professional development. ChatGPT can be used in Saudi secondary schools to enhance the teaching skills of female math teachers as it has the potential to serve as a virtual tutor and provide personalized learning experiences [11].

*Hypotheses 1 (H<sub>1</sub>): Secondary school mathematics teachers should have access to innovative and creative teaching techniques.*

*Hypothesis 2 (H<sub>2</sub>): In high school mathematics, female teachers have possessed some creative teaching skills.*

*Hypothesis 3 (H<sub>3</sub>): Using ChatGPT tools to develop the skills of secondary school mathematics, teachers will be perceived as appropriate, important and feasible by experts and specialists in mathematics education.*

To substantiate these hypotheses, employing ChatGPT as a strategy to enhance the pedagogical skills of high school math teachers is expected to yield positive outcomes. The enhancement of pedagogical capabilities among female math teachers in Saudi secondary schools through this approach is anticipated to be deemed viable, relevant and feasible by experts and professionals.

### 1.2. Research Goals

1. Enhancing high school mathematics teachers' creative teaching skills through ChatGPT AI activation.
2. Identifying essential creative teaching skills possessed by female secondary school math teachers.
3. Assessing the level of innovative teaching techniques among female secondary school math teachers.

4. Evaluating the proposed conceptualization framework from the point of view of experts and specialists.

### *1.3. Overview of the Literature*

In the realm of technology, artificial intelligence has been a pursuit spanning centuries evolving from mere imagination to tangible reality in the twenty-first century. The development of analytical mechanisms and self-deactivation mechanisms has fueled this progression marking a significant leap from historical conceptualizations. However, a consensus on a precise, multidisciplinary definition was imperative despite its paramount importance in the technological landscape. UNESCO [12] highlighted the need for a comprehensive understanding of AI as an expansive domain rather than a singular, identifiable concept. Various disciplines including computer science, logic and probability, anthropology, cognitive science, philosophy, neuroscience, psychology and linguistics have contributed to the multitude of definitions adopted for AI. It is recognized as a cognitive domain encompassing diverse subfields such as automated learning, robotics, neuronal processes, vision, natural language and speech sciences highlighting the intricate intersectionality within the realm of artificial intelligence.

In the face of swift technological advancements, the concept of artificial intelligence (AI) has undergone a transformative expansion. It is now conceptualized as a set of computational techniques and processes meticulously designed to enhance machines' intellectual capabilities. These capabilities encompass intricate tasks such as pattern recognition, computer vision and language processing as elucidated by Firat [13]. This definition underscores the essence of AI as a technical endeavor involving programming machines in a manner that enables them to simulate human thought processes with precision and sophistication. Artificial intelligence stands as a rapidly proliferating technique within the education sector, instigating transformative shifts across schools, teaching methodologies, learning approaches, educational environments, curricular frameworks and the broader education industry as highlighted by Ferlazzo [14]. The dissemination of AI technologies through social networks has led to a proliferation of interactive learning environments. These technologies encompassing IoT, block chain, nanotechnology, 3D printing, data science, robots and AI chat systems serve as fundamental components integrated into various educational systems. They operate as digital assistants employing simulation and automatic text functionalities to enhance user interactions marking a paradigm shift in educational practices.

The integration of artificial intelligence (AI) in mathematics education raises significant inquiries concerning the roles and competencies of teachers. It fundamentally reshapes the landscape of adaptive learning environments ushering in a new era of process-oriented scholarship. AI, in this context, possesses the capability to discern and comprehend learner psychology and progression at each stage of the learning journey. It provides targeted feedback encompassing cognitive processes, self-motivation, emotionality and social interactions as elucidated by Ali and Hamed [15]. This paradigm shift not only signifies a remarkable advancement in creative and innovative thinking within mathematics education but also empowers students to cultivate and enhance their mathematical and cognitive skills. Furthermore, AI applications in education represent a transformative technological frontier demonstrating remarkable efficacy in facilitating mathematics learning and bolstering students' problem-solving abilities. Additionally, these applications foster productive collaboration among students exemplifying their multifaceted impact on the educational landscape as noted by Popenici and Kerr [16].

#### *1.3.1. AI Models Improve Students Learning in Mathematics*

A range of AI applications have been identified to support student learning such as

1. Querium: Artificial intelligence provides specialized education in science, technology, engineering and mathematics to high school and university students. Analyzing the answers and the time it takes for STEM science, technology, engineering and math to complete the teaching sessions also gives teachers insights into students' learning habits. It identifies areas in which students can improve.
2. Knewton: It is an accessible curriculum integrated with Alta. Adaptability combines practice and learning that provides detailed explanations of the answer, textual instructions and videos, interactive learning content, review materials and integrated instructions promptly where students need support. Furthermore, it goes beyond the resolution of duties to address pre-required skill gaps. It is fully customizable to suit how a teacher studies and learns calculus, algebra and algorithms.
3. Cognii is based on artificial intelligence-based pedagogical techniques to teach students from kindergarten to higher education to help them determine the educational path based on a high-precision evaluation of the open response. The virtual learning assistant also uses the innovative EdTech of Cognii which combines communication pedagogical and artificial intelligence technique to address and engage the student in an educational conversation modeled on the chat robot by asking them to form an answer which can be mathematical issues, tips or mathematical concepts and giving them a high formative rating and tutoring.
4. Dragon Speech Integration: It helps students achieve their full potential for writing problems by allowing students to express themselves simply by speaking thereby reducing fears of writing and spelling that hinder and slow their way. It also helps the teacher prepare lessons more quickly is a more effective communication tool between teachers, students and administrators through e-mail and helps search on Google Voice instead of writing, providing more detailed observations when students are evaluated.
5. The Century Tech platform uses cognitive neuroscience and data analysis to create personal learning plans and reduce teachers' workloads. The AI system tracks students' progress, identifies knowledge gaps and makes recommendations for personal study and observations. It also provides teachers access to resources and reduces the time spent on planning, grading and managing household duties.

Previous research findings have consistently demonstrated the beneficial impact of deploying chat robots as manifestations of artificial intelligence in educational support. Moreover, the efficacy of a cognitive-based chat robot in nurturing science concepts and honing critical thinking skills among junior high school students has been rigorously investigated. A study by Roos [17] was particularly geared towards optimizing the educational utility of interactive chat robots, striving to attain maximal educational benefits. The age study referenced outcomes gleaned from log file data collected at the Smart Talk Robot site indicating that girls in the experimental group exhibited a notable proclivity for engaging with the chat robot to acquire specific information. Consequently, the employment of ChatGPT as a pedagogical aid by female students culminated in demonstrable enhancements in their learning outcomes as evidenced by their performance in learning assessments. This underscores the potent role of AI-driven educational tools in fostering educational progress.

Fryer et al. [18] aimed to recognize the potential role of online chat robots in overcoming problems such as time. 74% of students reported engaging in learning, interacting better with their colleagues and learning better through interactive chat robots. Bii P's study found that robots helped students understand and save time on learning. Most teachers enjoyed working with the AI and a few found it challenging. Bii et al. [19] argue that ChatGPT does support learning.

ChatGPT is a language model that produces text based on the probability for a word to occur in the sequence. It is very interactive can conduct realistic human-like conversations on various topics and can produce convincing and creative content [20]. It can also provide individual and interactive assistance to learners by helping them identify learning goals and important aspects of their preferences. ChatGPT can modify responses using user inputs and provide expert advice and assistance. As with specific technical information, Chat GPT (as a robotic program) often carries out a conversation accessed through several statutes including a website, smartphone application or correspondence service like OpenAI.

A study conducted by Haque et al. [6] suggests that ChatGPT has the potential to identify optimal practices and approaches for incorporating chat robots and other AI tools in educational settings. This research holds promise for influencing the future landscape of education and the integration of technology in learning. Teachers and students can enhance their use of these tools to foster learning and development by gaining insights into effective techniques. ChatGPT facilitates user interaction through both text and voice responses in real-time. Additionally, it can manage multiple concurrent chats with numerous learners catering to a diverse user base simultaneously. The utilization of ChatGPT's language model also offers users interactive assistance through natural and conversational interactions. ChatGPT possesses the capability to enhance accessibility and affordability of education. Moreover, it elevates the learning experience and fosters greater learner autonomy. The chat of GPT may have critical future effects on self-learning which require further research. In the context of self-learning. It needs to be kept in mind that Chat GPT is still a relatively new technique. Further study is needed to understand its potential and limitations properly. How have Chat GPT and other AI techniques evolved and how do they affect the subject of education? The development of AI tools such as Chat GPT has the potential to change the way students interact with professors and the world of education. The literature showed how AI technology can help improve learning [21]. Artificial intelligence-based teaching programmers can enhance students' performance and motivation in learning environments by providing ad hoc and interactive assistance.

One of the studies on the role of Chat GPT in education is Firat [13] in which it was found that Chat GPT is a promising tool for open learning that can improve the independence of learners, provide personal support, guidance, and observations and have the potential to increase motivation and participation among learners.

### *1.3.2. Creative Teaching Skills and their Concept*

Creative teaching is a strategy to promote innovative, effective and exciting learning and increase students' courage and critical thinking [22]. Research shows that creative teaching is closely linked to learning that develops students' potential. Teachers have the skills to plan, manage and evaluate appropriate learning to develop student's creativity and critical thinking potential. The habits implemented to promote creative teaching include openness to students, thinking, building trust and security, stimulating critical thinking, tolerating mistakes, promoting cooperation and giving students opportunities to build concepts, solve problems and think across disciplines [23, 24].

Chen et al. [5] defined creative teaching as the teacher's response to the student's individual needs proactively seeking innovation and creativity and designing rich and innovative content with attractive teaching methods to improve students' motivation to learn and thus improve learning outcomes to achieve practical teaching goals. The entrepreneur of Eric defined creative teaching as the development and use of new, original or innovative teaching methods. Creative teaching can make learning active and experimental helping to enhance students' professional knowledge and social and emotional skills. Abdel Aziz et al. [25] summed it up as a set of teaching behaviors and procedures performed by the teacher in the educational situation, including skills for organizing the learning environment that stimulates creativity using new ideas and various entry points, directing the imagination of learners and motivating them to achieve creativity in educational attitudes and employing creative evaluation techniques that take into account accuracy, speed and compatibility with the educational situation.

Researchers noted that creative teaching occurs when teachers collect relevant teaching materials through creative teaching activities, creative teaching plans and improved creative teaching strategies thereby improving the effectiveness of students learning.

### *1.3.3. Characteristics of Creative Teaching*

Research has stated that one of the characteristics of creative teaching is cooperation and innovation. Therefore, cooperation between teachers and learners must be developed appropriately. So, innovations made by teachers during a



lesson facilitate the building of student knowledge. The nature of creative teaching is also reflected in the strategy of choice of teaching, namely (a) student-centered learning, (b) diverse teaching strategies, (c) classroom management that facilitates diversity according to students' potential, (d) contextual teaching of daily life, and (e) training of students in critical thinking through questions and answers as well as discussion [26].

They also consider that creative teaching contributes to the achievement of educational goals at the highest level and considers the needs of learners and the characteristics of their development. It aims to achieve integrated development (mental, gender, emotional and social). The learner is at the center of the educational process without neglecting the teaching material or the role of the teacher. The learner can reorganize scientific knowledge and link it in new ways. Creative teaching also manifests itself in learner behavior and can be observed and measured, motivating learners to think, active dialogue and individual learning. The most essential requirements of creative teaching are to reformulate the curriculum so that the development of learners and creative abilities is considered in its approach. It is essential to use modern teaching methods such as self-learning and brainstorming. One of the studies on the reality of teachers' creative teaching is [Abu Dawla and Zaza's \[27\]](#) study which aimed to learn about the reality of teachers' creative teaching practices and found that the practices were moderate and recommended the development of teachers' creative teaching skills.

#### *1.3.4. Classification of Creative Teaching Skills*

Researchers have taken a different approach to classifying creative teaching skills including creative teaching, depending on the primary creative skills:

- Fluency is the ability of an individual to produce many ideas suited to the demands of the natural environment including ways, proposals, questions and alternative answers.
- Flexibility is the ability to generate diverse ideas, answers and questions from different perspectives and patterns and to develop the ability to convey these patterns and change the mindset. It is the ability of a person to change his or her mental state by changing the situation. There are two types of flexibility: Automatic flexibility is the ability to give several diverse and non-category responses. Adaptive resilience is the successful behavior to confront particular problems or situations. Originality is the ability to generate ideas to solve problems and create unique and distinctive ideas.
- Detail is an individual's ability to develop ideas and details to make them more useful, beautiful, and accurate by articulating their meaning at length [28].
- Problem sensitivity means seeing many problems in the situation that one faces and being able to recognize the mistakes, shortcomings and inadequacies of the situation in which he is found, trying to fill the gaps that he discovers, and trying to discover and understand the stranger in the situation that he faces. Among the studies that revealed the most critical creative abilities that determine the creative potential of individuals, creative teaching skills were categorized according to the primary creative skills. Others addressed creative teaching through stages of the teaching process (planning, implementation, evaluation and classroom management in the learning environment).
- Teaching planning skills are the theoretical teacher planning before entry into the classroom and include many skills, the most important of which are the analysis of content and the organization of follow-up, the formulation of objectives for the lesson, the identification of activities and tasks, the characterization of learners, the selection of methods and methods of evaluation and the definition of extracurricular duties and activities [29].
- Several studies have also been concerned with identifying and developing creative teaching skills among teachers, such as the [Al-Marri \[30\]](#) which has determined the impact of using active learning strategies to develop creative teaching skills among mathematics teachers and the [Alaswad \[31\]](#) which has identified creative teaching skills suitable for practicing fundamental teaching standards among Arabic language teachers.

## **2. Methodology**

The research employed an analytical-descriptive approach which entailed reviewing relevant prior research to inform the researcher align the study's objectives and address specific research questions. The research community is represented by 100 female math teachers in secondary schools. The sample was selected in a random, cluster-class manner and was 31 female teachers in size. The research focuses on creative teaching skills represented by planning, implementation and evaluation as well as the main skills of creativity represented by fluency, flexibility and originality.

### *2.1. Research Tools*

1. A closed interview card aimed at evaluating the inventive teaching methods and creative teaching skills of secondary school math teachers.
2. Teacher instruction card (detailing procedures for activating the artificial intelligence model Chat GPT).
3. The proposed conceptualization is based on the activation of the artificial intelligence model Chat GPT to develop the creative teaching skills of secondary school mathematics teachers. The scenario suggested by this research involves activating the ChatGPT AI model to support high school math instructors in enhancing their creative teaching techniques.

### *2.2. Research Procedures*

First: Constructing the interview cards.

An interview card containing creative teaching skills was prepared to be applied to a sample of secondary school mathematics teachers and was built in light of a list of creative teaching skills as follows:

- The collected data was determined to be related to the objectives of the study.
- Reviewing the theoretical literature and Arab and foreign studies related to the research topic to prepare the card.
- Formulating the phrases under each axis in a way that is easy and clear to the respondents.
- Taking the opinion of experts and specialists.

In accordance with the previous procedures, the card was built in its initial form which included the following axes:

The first axis is creative teaching skills related to planning and includes 11 paragraphs.

The second axis is creative teaching skills related to implementation and includes 14 paragraphs.

The third axis is creative teaching skills related to evaluation including 12 paragraphs.

They were answered according to a four-point scale corresponding to each paragraph of the card (often, sometimes, rarely and never) and for the purpose of processing, the researcher gave each response to each paragraph of the card a specific value as follows: Often (4 points), sometimes (3 points), rarely (2 points) and never (1 point).

### 2.3. Validation of the Instrument

To ensure the validity of the tool, it was presented to 11 specialists in curricula and teaching methods to get their opinions. The wording of some phrases was modified and the list came out with a total of 41 phrases.

Stability of the tool: The stability was calculated by Fakornbach's formula and was 0.93.

Second: A proposed conceptualization to activate the artificial intelligence model Chat GPT in developing the creative teaching skills of secondary school mathematics teachers.

1. Several studies by [Dimitriadou and Lanitis \[32\]](#) and [Lee and Lee \[33\]](#) dealt with the Chat GPT model and teachers' creative teaching skills and were reviewed to develop the proposed conceptualization of developing the creative teaching skills of secondary school mathematics teachers.
2. Preparing a card for the procedures for activating the Chat GPT model.
3. Developing a proposed conceptualization to activate the artificial intelligence model Chat GPT in developing the creative teaching skills of secondary school mathematics teachers based on the following key points:
  - Premises and determinants of the proposed conceptualization.
  - Objectives of the proposed conceptualization.
  - Sources for preparing the proposed conceptualization.
  - The content of the proposed conceptualization.
  - The importance of employing the artificial intelligence model Chat GPT.
  - Mechanism for activating the Chat GPT model.
  - Components of the proposed conceptualization.
  - Implementation requirements for the Chat GPT artificial intelligence model.
  - Suggested actions.

Validation of the procedure card for activating Chat GPT Seven experts in curriculum and teaching methods evaluated the tool's validity. Based on the expert's evaluation and suggestions, the wording of some phrases was modified for 57 items and the list came out with a total of 34 phrases based on which the proposed conceptualization was developed.

Ensuring the appropriateness, relevance and applicability of the conceptualization, statistical processing methods the data was analyzed using the following statistical methods:

1. Frequencies and percentages.
2. Arithmetic mean and standard deviation to calculate the value given by the sample members to each paragraph.
3. Cronbach's alpha to calculate the stability of the instrument.

## 3. Research Results and Discussion

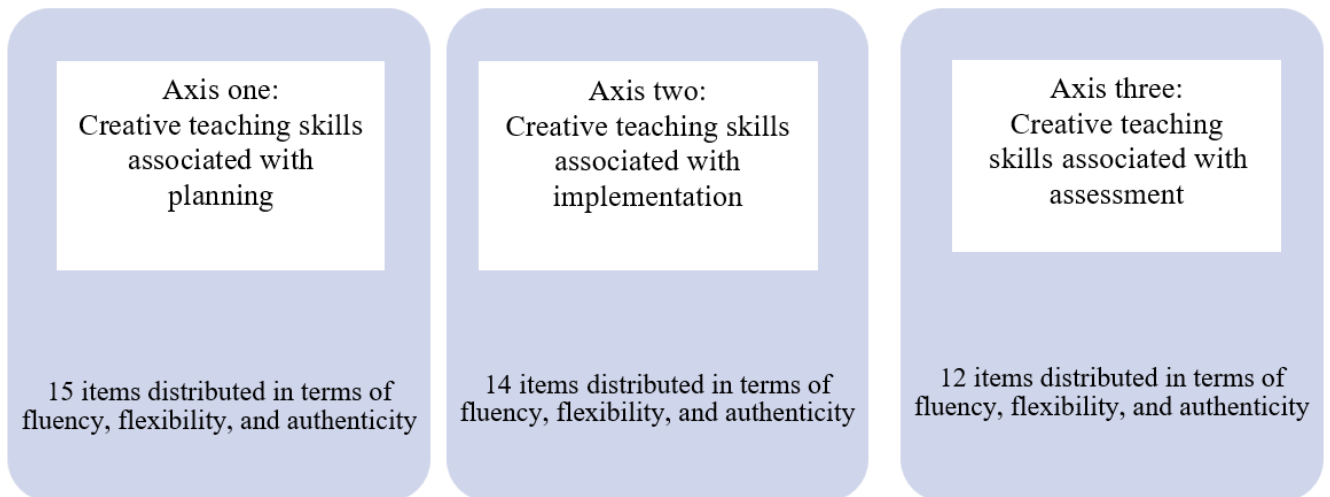
*Hypotheses 1 (H<sub>1</sub>): Secondary school mathematics teachers should have access to innovative and creative teaching techniques.*

What are the appropriate creative teaching techniques that should be made available to mathematics teachers in secondary schools? The identification of creative teaching skills and the examination of previous research conducted by [Ali and Hamed \[15\]](#), [Rashwan \[22\]](#), [Al-Maliki \[34\]](#), [Al-Mutairi \[35\]](#) and [Mahmoud et al. \[26\]](#) have led experts and previous studies to draw conclusions. A comprehensive list of innovative teaching abilities specifically for female secondary mathematics teachers was formulated considering the concept of innovative teaching abilities and prior investigations that have explored the importance of these abilities in teachers. This list was then evaluated by professionals and experts in the fields of curricula, pedagogical approaches and technology.

This study found that it's really important for teachers to have creative thinking skills when teaching math at all school levels. We need to encourage a group of creative and pioneering educators to help students do well in their studies whether they learn creative thinking directly or indirectly.

This study underscores the critical importance of equipping teachers with creative thinking skills particularly in the context of teaching mathematics across all school levels. The findings emphasize the necessity of fostering a cadre of innovative and pioneering teachers who can effectively impart mathematical concepts to students. It is imperative to cultivate an environment where teachers are empowered to employ creative approaches in their pedagogy whether through direct instruction in creative thinking techniques or through indirect exposure to innovative teaching methodologies. Numerous studies have highlighted the significance of incorporating creativity into math education comparing these findings with existing research. Research by [Ali and Hamed \[15\]](#), [Rashwan \[22\]](#), [Al-Maliki \[34\]](#) and [Al-Mutairi \[35\]](#)

demonstrated that teachers who integrate creative thinking strategies into their math instruction not only enhance student engagement but also facilitate a deeper understanding of mathematical concepts.



**Figure 1.**  
List of creative teaching techniques.

Figure 1 illustrates a list of creative teaching skills that should be possessed by secondary school mathematics teachers. It was prepared and validated by experts and specialists in curriculum, teaching methods and technology. It was distributed as follows:

Axis One: Creative teaching skills related to planning including 15 items distributed across the levels of fluency, flexibility and authenticity.

Axis Two: Creative teaching skills related to execution including 14 items distributed across the levels of fluency, flexibility and authenticity.

Axis Three: Creative teaching skills related to assessment including 12 items distributed across the levels of fluency, flexibility, and authenticity.

The list of creative thinking skills is important for identifying some of the creative behaviors among teachers to foster creativity in teaching mathematics at various educational stages. This plays a role in preparing a generation of innovators, scientists, and creators, enhancing students' performance and academic achievement levels whether through direct or indirect methods of learning creative thinking skills. This is the desired goal of the educational process.

*Hypothesis 2 (H<sub>2</sub>): In high school, mathematics female teachers have possessed some creative teaching skills.*

The development of the interview card was undertaken in accordance with the creative teaching skill list. Certain criteria have been employed to assess the extent to which female teachers possess the ability to teach creative teaching skills. The estimation score for those who lack the necessary skills falls within the range of 1-2. On the other hand, those who possess average proficiency in this area obtain an estimation score of 2.2.01.3. A higher level of proficiency is indicated by an estimation score of 3x1-4. The mean and standard deviation have been computed for each dimension of the assessment tool to address the research questions.

Interpretation of the first axis and creative teaching skills are associated with planning.

**Table 1.**  
Arithmetic averages, standard deviation and level of mastery of creative teaching skills.

Mastery level	Standard deviation	Arithmetic mean	Level	Axis
Average mastery	0.216	2.820	Average fluency	Creative teaching skills associated with planning.
Average mastery	0.199	2.440	Average flexibility	
Average mastery	0.448	2.319	Average authenticity	
Average mastery	0.166	2.473	The first axis	Creative teaching skills associated with the implementation.
Not capable	0.351	1.615	Average fluency	
Not capable	0.315	1.644	Average flexibility	
Not capable	0.361	1.601	Average authenticity	Creative teaching skills associated with assessment.
Not capable	0.299	1.615	The second axis	
Not capable	0.379	1.639	Average fluency	
Not capable	0.267	1.773	Average flexibility	The proficiency level for creative teaching skills.
Not capable	0.469	1.642	Average authenticity	
Not capable	0.25626	1.6959	The third axis	
Not capable	0.18314	1.9558	Total	

Table 1 demonstrates that the mean values of the sub-indicators pertaining to creative teaching skills varied between the values of 1.6 and 2.8. In the first category, the creative teaching skills related to planning were characterized by an average fluency level of 2.8 with a standard deviation of 0.12 indicating a level of average mastery. This outcome can be attributed to various factors with the most significant ones being inadequate knowledge of the fundamental steps involved in planning a creative lesson and insufficient training in creative teaching skills. In sequential investigation [36] the emphasis is on the significance of exemplary teacher preparation and its impact on the execution of pedagogical tasks and the quality of the educational output.

The underperformance of students can be attributed to insufficient public policies that should have allocated resources to preparation program initiatives aimed at reforming the educational process and enhancing teacher performance.

The level of flexibility is indicated by the arithmetic average of 2.4 with a standard deviation of 0.19. Additionally, there is a level of average mastery. These results may be attributed to the inclusion of various factors. One such factor is the learners' unfamiliarity with formulating objectives that promote flexibility. Another factor is the need for learners to be aware of the skills required to approach problem-solving from multiple perspectives. Furthermore, the limited knowledge and utilization of technology during lessons can hinder effective planning. At the level of authenticity, the arithmetic means of two plus three yielded a standard deviation of four hundred and forty while the mean level of probability rating stood at four percent.

It is possible that the cause lies in the difficulty people face when planning for original and creative ideas, solutions as well as complex and novel tasks. This particular skill necessitates learning and acquisition to exercise it optimally. Teachers may lack sufficient knowledge to devise plans that guide their students towards unique solutions and enable them to deduce and interpret new connections. Furthermore, they may lack the necessary expertise to inspire their students to innovate within the realm of education. Additionally, they may be inclined to adhere to the conventional pattern of rote learning without addressing novel thinking or alternative solutions.

It is crucial for them to possess sufficient enthusiasm to design plans that encourage their students to generate genuine solutions and unconventional ideas.

In its entirety, the axis achieved an arithmetic mean of 2.4 with a standard deviation of 0.16 and an average aptitude score. This can be attributed to the lack of fully available creative teaching skills related to planning which has resulted in a macro-level reversal of the axis.

Interpretation of the second axis and creative teaching skills are associated with implementation.

In the second axis, the mean level of fluency (1.6) displayed a standard deviation (0.35) that is considered unmanageable. This could be attributed to the conventional school environment. According to Al-Juhani [37] and Al-Mutairi [35] the traditional layout of the school environment hampers innovative instruction, necessitating its adaptation to the demands of contemporary education and the provision of environmental spaces for occasions. Teachers can attain their creative objectives through the continuous enhancement of the school environment. However, student progress within the classroom may pose a hindrance to creative teaching and impede its realization. This limitation in ability can be ascribed to the limited availability of instructional aids and techniques for teachers to foster creative instruction. Moreover, teachers may face frustration due to their students' lack of responsiveness towards creative activities or their preference for traditional teaching.

Teachers teaching methods as well as their limited capacity to articulate their perspectives, opinions, and ideas influence response. The students' responsiveness can be attributed to the teacher's failure to implement creative teaching skills during class and may also result from insufficient support from the teacher in implementing creative ideas. The failure of teachers to promote creative thinking through management and supervision does not facilitate the release of their creativity or the overcoming of obstacles. The arithmetic average level of flexibility (1.6) was a standard deviation (0.13). It is level (unable).

The lack of relationship between the concepts, principles and theories in the curriculum and the real world as well as the absence of novelty, dynamism and creativity in the design of learning activities by the teacher can be identified as the primary reason for this issue. Al-Jamal [38] suggests that this could be due to inadequate numbers, insufficient training, fear of failure and the challenges associated with classroom management. The preparation of teachers has only recently started incorporating creative skills though in a limited manner through basic signals and insufficient courses which hinders the development of creative teaching abilities. Furthermore, there is a lack of acceptance for those who do not possess such skills.

The mean level of authenticity (1/6) demonstrates a low standard deviation (0/25) indicating an unfavourable level. The teacher may face difficulties in teaching the curriculum due to their adherence to teaching methods that may not adequately address the needs of students. The teacher's approach goes beyond the traditional framework of classroom management. However, the lack of support for a culture of self-learning and the joy of learning as well as the absence of innovative projects and new connections between concepts contribute to this challenge.

The average score for the axis is 1.6 with a standard deviation of 0.29 indicating an unfavourable rating. This is primarily due to the insufficient availability of creative teaching skills and their implementation which has a significant impact on the macro-level performance of the axis.

Explanation of the second axis: Creative teaching skills are associated with evaluation.

The mean fluency level (1.6) had a standard deviation (0.73) and was considered insufficient. This could be attributed to teachers lack of training in assessment methods throughout their educational journey. These methods should be designed, introduced and formulated rather than solely relying on information retrieval. As a result, teachers depend on alternative



approaches to evaluation that prioritize higher cognitive objectives and foster creativity in learners. Perhaps this is due to the emphasis of tests on measuring lower cognitive skills.

The mean flexibility level (1.7) had a standard deviation (0.26) and was also considered inadequate. This could be attributed to teacher’s use of tasks that fail to motivate students and the limited options for task achievement. Furthermore, students may not have access to educational resources that facilitate creative assessments or may not be familiar with the proper steps for utilizing such resources. It is important to note that the diversity of educational tools significantly contributes to creating an appropriate classroom environment for creativity which may not be fully supported in the context of math education.

The average level of authenticity, calculated through arithmetic means (1/6) exhibited a standard deviation of (0/46) and is considered to be at an inadequate level. This could potentially be attributed to the lack of interest displayed by female teachers towards open-ended questions that foster divergent thinking. The utilization of memory-based activities is prevalent while activities that promote creativity and its development are neglected. Moreover, the application of original assessment methods for ideas, solutions and creative tasks is perceived as challenging as it requires a significant amount of imagination, creativity and learning.

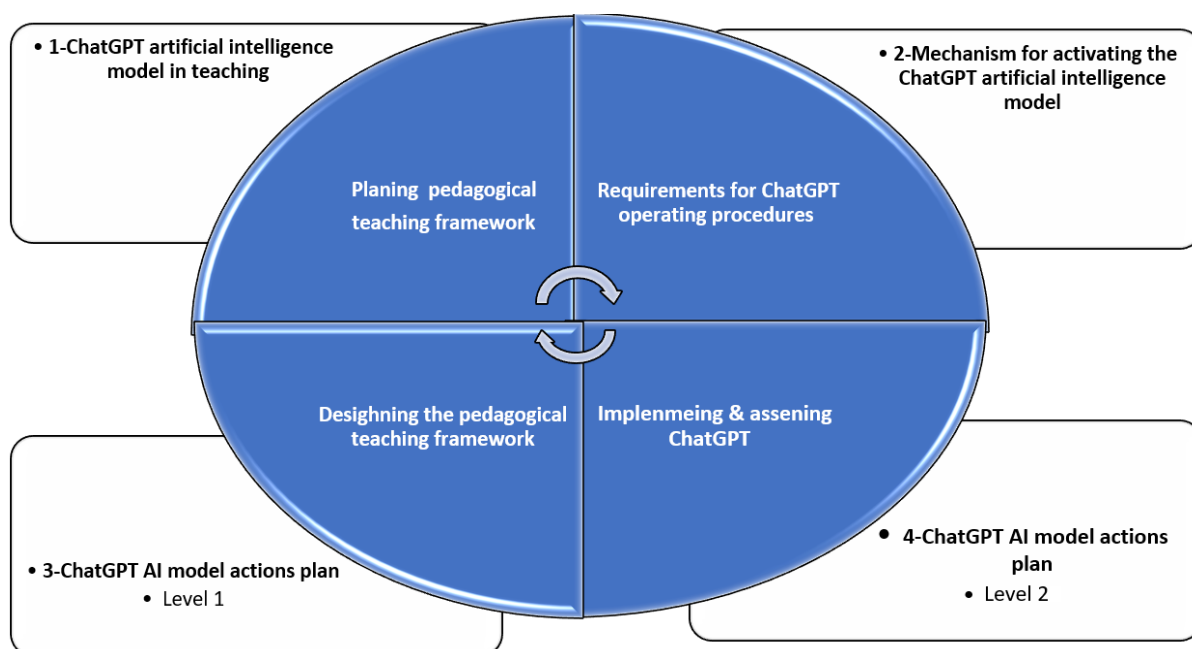
The third axis, when analyzed yielded an arithmetic average of 1.6, a standard deviation of 0.25 and an unfavorable rating. This can be attributed to the inadequate availability of creative teaching skills associated with evaluation, thus affecting the overall reversal at the macro level of the axis. The axis exhibited an arithmetic average of 1.9, a standard deviation of 0.18 and an unfavorable rating due to the insufficient availability of creative teaching skills associated with planning, implementation, and evaluation resulting in an impact on the reversal at the macro level of all three axes.

This research investigation aligns with certain discoveries that indicate a deficiency in educators' capability to acquire innovative pedagogical abilities, as demonstrated by Abu Dawla and Zaza [27], Barsoum, et al. [39], Al-Marri [30] and Al-Mutairi [35]. Al-Shammari [29] and Mahmoud [40] diverge from preceding studies. This current study uses a corresponding card and a proposed program as opposed to the prior employment of an instrument for active learning and an entry point. Both STEM and surveys [41, 42] contribute to the overall body of research. The contributions of this study encompass the creation of AI system storyboards that are technically viable and support learner-instructor interaction in a positive manner, the identification of students' and instructors' concerns regarding AI systems through the employment of speed dating and the provision of practical implications for maximizing the positive influence of AI systems while minimizing any negative ramifications [43].

*Hypothesis 3 (H<sub>3</sub>): Using ChatGPT tools to develop the skills of secondary school mathematics teachers will be perceived as appropriate, important and feasible by experts and specialists in mathematics education.*

A framework has been created to use the AI model ChatGPT to improve the creative teaching skills of female mathematics teachers in secondary education. This proposed concept aims to encourage the use of ChatGPT to develop the creative teaching abilities of female secondary mathematics teachers through a set of practical proposals. The investigation resulted in the identification of key principles and parameters guiding this framework. The ensuing principles and parameters have been meticulously formulated for the proposed framework.

The efficacy of using ChatGPT within the educational context as evidenced by the findings of this study highlights its significant contribution. The proposed framework is confined to secondary mathematics teachers. It encompasses various sequential stages and procedures pertaining to the application of the ChatGPT model in fostering creative teaching skills associated with lesson planning, implementation and evaluation.



**Figure 2.** ChatGPT enhances the pedagogical skills proposed in the framework.

The aim of the proposed framework is to foster the utilization of the ChatGPT model to enhance the innovative pedagogical abilities of female mathematics teachers within the secondary school context. Teachers will ascertain the requisite steps and procedures involved in deploying ChatGPT. They will possess the knowledge to compose the necessary prompts for tasks and to solicit additional information for the purpose of clarification and integration into instructional practices, pedagogical approaches, evaluative measures, promotional endeavors and feedback mechanisms.

Several studies have been consulted regarding the application of the generative AI model ChatGPT in the field of education [20, 44-48]. The findings of previous research studies have highlighted the limited utilization of the ChatGPT model among teachers, as well as its novelty within the realm of artificial intelligence. The results obtained from surveys conducted further underscore the necessity for increased incorporation of artificial intelligence tools in instructional practices [49].

Figure 2 illustrates four levels of using ChatGPT to improve teachers' pedagogical skills. First: The importance of using the ChatGPT artificial intelligence model is in teaching.

Firstly, we must acknowledge the significance of employing the ChatGPT artificial intelligence model in the realm of education. This utilization holds the potential to assist teachers in effectively strategizing their teaching methodologies, thereby optimizing their instructional efforts. Additionally, it enables them to economize time by streamlining the process of devising innovative lesson plans, setting goals and organizing activities. Furthermore, it equips teachers with a diverse range of inventive teaching concepts, thereby promoting pedagogical creativity. The ChatGPT model ensures that each subsequent query elicits distinct responses, eliminating redundancy or repetition in the answers provided.

Teachers greatly appreciate the swift response rate facilitated by the utilization of ChatGPT as well as its capacity to facilitate ongoing communication with their students. In a broader sense, this study contributes significantly by developing storyboards for AI systems that are both technically feasible and supportive of learner-instructor interaction. Moreover, it addresses the concerns of students and instructors regarding AI systems through the implementation of a speed dating methodology. Ultimately, the study offers practical implications for maximizing the positive impact of AI systems while mitigating the negative consequences associated with their implementation [43, 50].

Second: The mechanism for activating the ChatGPT artificial intelligence framework:

Requirements for the operational procedures of the proposed ChatCPT must be taken into consideration prior to utilizing ChatGPT to effectively use the system and overcome any potential shortcomings that may arise in certain responses. When teachers intend to employ ChatGPT, a means of activation through a question-and-answer format is used, whereby the system is directed and prompted to provide the desired information.

Upon commencing the conversation, a query or request is posed with specific instructions regarding the type of task to be carried out. For instance, teachers may inquire about innovative and distinctive resources or request information regarding processes and interactive resources.

Continual enhancement of the conversation with ChatGPT is achieved by posing more precise and varied questions. More comprehensive and valuable information is obtained by requesting modifications to previous responses and asking ChatGPT to elaborate on specific aspects. If teachers discontinue providing input, ChatGPT is prompted to continue the interaction and provide further responses.

If certain crucial questions frequently arise in educational settings, ChatGPT is prompted to include these questions as part of the activities.

It is possible for errors to occur in the answers or the data. The initial conversation may not yield the desired outcome, but this does not imply that another attempt with a different formulation should not be pursued. The Chat GPT model relies on teachers to critically evaluate the responses and resources obtained ensuring their accuracy and suitability.

Third: Action plan associated with the activation of the ChatGPT AI model in creative teaching.

Phase 1:

Teachers request the implementation of flexible instructional plans that consider the needs of learners and align with the scope and sequence of the curriculum. For instance, establish a lesson plan centered around the topic being taught, incorporating a range of activities and assessments and consider the following passage (briefly describing students' abilities and knowledge). Teachers can construct educational objectives that prioritize the cultivation of adaptability, and ingenuity skills. Teachers seek ideas for innovative teaching strategies based on data analysis that facilitate female students in exercising their creative thinking abilities taking into consideration their needs and request a breakdown of these strategies and their implementation and use approaches to instruction that foster creativity and provide insights into the subject matter and content of the lesson.

Teachers are tasked with compiling a list of four teaching strategies that promote creativity among students and can be utilized to address their learning needs. They should also indicate how these strategies are put into practice.

Phase 2:

An examination is being conducted to assess the effectiveness of various teaching strategies in fostering learners' creativity. For instance, compiling a list to assess the efficacy of a particular strategy (identifying it) in its application with learners.

The ChatGPT is instructed to establish a task that concludes a lesson or summarizes key tasks or points of the lesson while specifying its name and the way it desires to present the ideas whether through a diagram or a question, etc. For example, create a task that prompts students to summarize the main points of a lesson creatively and initially, thereby facilitating their understanding and retention. Require ChatGPT to generate open-ended inquiries corresponding to the educational objectives and criteria for the success of the unit. For instance, devise an open-ended query that evaluates the student's comprehension of the parabola concept in the Cone Cuts lesson. Furthermore, ensure inclusion of all the essential

determinants for formulating the question. The development of individual sporting activities, innovative educational tasks, and other collaborative endeavors serve to delineate the subject matter and requisite particulars. Solicit ideas and questions that encourage learners to articulate their perspectives such as creating queries that necessitate students to express their viewpoints in the science class in high school. Request miscellaneous queries for exploration and self-discovery.

Establish a diverse array of strategies that are crucial and explicit to facilitate prompt feedback. For instance, compile a repertoire of strategies that provide lucid and indispensable guidance, ensuring timely feedback (to be specified). Teachers should design flexible and varied tasks tailored to the unique needs and capacities of each student. Teachers can introduce challenges, such as crafting a demanding task for students who possess a firm grasp of the taught concept, while simultaneously offering support to students grappling with understanding the subject matter. Devise class questions and ideas to inspire learners to summon forth as many appropriate mathematical ideas as possible within a given timeframe.

Examples and models of high-quality and creative responses are created to showcase and raise learners' creativity. The creation of formal, descriptive or visual stimuli encourages learners to produce many solutions and representations. Original and new ideas on the subject of study need to be more familiar to female students [51-54]. Educational aids and exciting materials are created to develop students' creativity and motivate them to propose new and unique ideas. ChatGPT offers intelligent applications, tools and programs to develop creativity and innovation. Suggestions are made for a flexible and safe learning environment that promotes the exchange of diverse ideas and the development of solutions. Incentives are suggested to support learners' original ideas. Diverse ideas for alternative evaluation methods are generated. ChatGPT suggests various assessment methods and ideas for using technology to improve assessment and feedback. Ideas are created for different data types that teachers can collect to monitor students' learning and progress. Various non-repetition terms are proposed to evaluate learners' work. Formative evaluation activities provide continuous feedback during teaching and learning. Interactive tests and simulations are created to help students practice and apply what they have learned. Final evaluations assess student learning at the end of the unit.

**3.1. The Implementation of ChatGPT AI Model**

Inclusion of teachers in training courses to familiarize themselves with ChatGPT, its setup procedures, utilization techniques and strategies for effectively engaging with it to fulfill the requirements. Conducting training sessions on the functionalities of artificial intelligence systems to ensure awareness and continuous monitoring of model enhancements and alterations in the services rendered. Vigilantly observing the challenges faced by female teachers during the implementation of the model and endeavoring to resolve them. Among other objectives, teachers display a keen interest in enhancing their proficiency in incorporating artificial intelligence into their instructional practices. Facilitating the establishment of networks among instructors to exchange knowledge on its utilization, the benefits they have derived, the obstacles they have faced, and the approaches employed to overcome them.

**Table 2.**  
Experts' views on the proposed ChatGPT framework.

Standard	Applicability of the proposed framework		The relevance of the proposed framework		Applicability and feasibility	
	Appropriate	Not suitable	It is important.	Does not matter	It is possible.	It is not
No. of expert responses [44]	9	0	9	0	9	0
Ratio	100%		100%		100%	

The recommended action plan includes organizing seminars that encompass the prerequisites for adopting the AI model, the advantages and disadvantages associated with it, and strategies for its application in teaching. Additionally, it is advised to propose training programs tailored for female instructors who aspire to use ChatGPT, an AI model within their classrooms. The conclusion of this research is the opinion of experts and professionals regarding the proposed framework in relation to its feasibility, relevance and applicability. The framework has been presented to a panel of nine experts specializing in curriculum design and teaching methodologies. The outcomes of their evaluation are outlined in the subsequent table. Table 2 illustrates the approval of the proposed approach for enhancing the creative teaching abilities of female secondary mathematics teachers through the activation of the AI model ChatGPT. This endorsement, achieved unanimously at a 100% rate according to established arbitration standards, highlights the concept's significance, pertinence, and practicality. The unanimous agreement among perception arbitrators can be attributed to a perceived necessity for the improvement of teaching skills among female teachers. The activation of artificial intelligence aligns with the pivotal role it plays in the Kingdom [55]. The overarching goal is to implement artificial intelligence across various sectors, including education. Stakeholders believe that the vision is well-positioned to address this need systematically constructed and evaluated against scientific criteria that affirm its importance, relevance and applicability.

**3.2. Research Recommendations**

1. Decision-makers must recognize and prioritize the effective utilization of artificial intelligence tools and models within the education system. It is crucial to convey the paramount importance of incorporating these technologies.

2. Teachers unanimously agree that integrating artificial intelligence into education is not just essential but also requires continuous adaptation to technological advancements. Furthermore, teachers should actively enhance their teaching skills by gaining expertise in technology, particularly in the realm of artificial intelligence.

### 3.3. Research Suggestions

Using the AI model, ChatGPT has demonstrated a significant improvement in the academic performance of female middle school teachers in an educational setting.

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