

## Research Article

Cite this article: Alkhurfan, L., & Al-Refai, A. (2025). The Effect of the Multimedia-Supported Pentagon Strategy on Cognitive Depth in Social Studies. *Educational Process: International Journal*, 18, e2025497. <https://doi.org/10.22521/edupij.2025.18.497>

Received July 14, 2025

Accepted September 28, 2025

**Keywords:** Pentagon, Multimedia, Cognitive Depth.

**Author for correspondence:**

Lilian Alkhurfan

 [lylyanalkhurfan83@gmail.com](mailto:lylyanalkhurfan83@gmail.com)

 Department of Curriculum and Instruction, Yarmouk University, Jordan.

## The Effect of the Multimedia-Supported Pentagon Strategy on Cognitive Depth in Social Studies

Lilian Alkhurfan , Abeer Al-Refai 

### Abstract

**Background/purpose.** The current study aimed to identify the effectiveness of employing the multimedia-supported pentagram strategy on cognitive depth in social studies in developing students' cognitive depth.

**Materials/methods.** The current study employed a quasi-experimental approach to study the Pentagon strategy in teaching Islamic Civilization to seventh-grade females at Jawharat Al-Manara Secondary School, affiliated with Bani Obaid District, Irbid, during the academic year 2024/2025. The study material, a teacher's guide for the Pentagon strategy, was verified for validity and reliability. A cognitive depth test was also developed, and the sample was divided into two groups: a control group of 19 students and an experimental group of 19 students, both of whom were randomly selected for the study. The study aimed to understand the effectiveness of the Pentagon strategy in teaching Islamic Civilization.

**Results.** The results showed a statistically significant difference between the average performance of the experimental and control groups on the cognitive depth test as a whole and for each of the cognitive depth skills (remembering, application, extended thinking, strategic thinking), attributed to the teaching method (regular and pentagram), and in favor of the experimental group that studied using the pentagram strategy. The size of the effect resulting from the use of the pentagram strategy amounted to 63.3%.

**Conclusion.** The Pentagon strategy significantly improved cognitive depth skills among seventh-grade students in social studies through the use of open-ended questions, analysis, interpretation, and real-life applications. This approach is effective for designing educational situations targeting advanced thinking, especially in primary education. The study recommends incorporating activities, training teachers, and comparing the effectiveness of the Pentagon strategy with other cognitive strategies.



OPEN ACCESS

© The Author(s), 2025. This is an Open Access article, distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted re-use, distribution, and reproduction, provided the original article is properly cited.

## 1. Introduction

Education is crucial for societal advancement and prosperity, contributing to a distinguished future for individuals and ensuring social and economic development for nations. Countries strive to develop the educational process, including students, content, teaching methods, teachers, and the educational environment. As the world continues to evolve, it is essential to reconsider conventional teaching methods and develop more effective strategies. Teachers play a pivotal role in the educational process, using diverse and stimulating methods to enhance students' capabilities, encourage different routines, and develop observation and inference skills. Developing effective teaching strategies is essential for enhancing the quality of education, facilitating knowledge transmission,, and creating an educational environment that fosters deep thinking.

The researcher believes that numerous conventional teaching methods and strategies are employed in social studies education, which in turn help improve the educational process. However, it has become necessary to consider new methods that keep pace with the educational process and increase student activity and effectiveness, such as the Pentagon strategy, which places students at the center of the educational process and contributes to transforming their roles from recipients to researchers, acquirers of information, and participants in its production. Therefore, the current study tries to answer this question: "Are there statistically significant differences at the significance level ( $\alpha = 0.05$ ) between the mean scores of the experimental group and the mean scores of the control group on the cognitive depth test attributable to the teaching method (traditional, Pentagon strategy)?"

The advantages of the Pentagon strategy include developing higher-order thinking skills among students, enhancing their intellectual performance, cultivating life skills, and promoting advanced thinking, which reduces costly errors and aligns with educational technology and modern techniques. It also serves to attract attention, stimulate motivation among students, and transform the learning process from a traditional to an enjoyable one (Adel, Ibrahim, 2021).

The researcher believes that the nature of social studies subjects, the aims of teaching them, and the extent of expectations hoped to be created in students' knowledge, emotions, and behaviors require a reconsideration of their outlines in preparation for the expected change in social studies in students' minds, so that their content and ideas are dealt with far from being a subject for memorization and recollection, but rather for depth, contemplation, thinking, and preparation for the future by arming themselves with the necessary skills that contribute to strengthening what students already possess.

Educational multimedia is one of the most effective tools for enhancing learning. It provides a rich learning environment that combines images, audio, and video, increasing student engagement and stimulating their attention. These media facilitate the understanding of complex information and make the learning process more enjoyable and effective (Mayer, 2009). Studies indicate that the use of multimedia in education enhances learners' critical thinking and self-reflection skills, as these media enable students to receive information through multiple senses simultaneously, which supports their comprehension better than traditional methods that rely solely on text (Clark & Pylyavskyy, 2016).

The levels of cognitive depth are represented by four main levels: remembering, applying, strategic thinking, and extended thinking, as indicated by Webb (2002). These levels are characterized by a cumulative and integrative relationship, and mastering each level is a prerequisite for moving to the next higher level, ensuring the gradual and organized construction of knowledge.

The study confirmed the effectiveness of the Pentagon strategy in developing geographical and historical reasoning among social studies teacher students as a whole. The results of the study were

consistent with many foreign studies, such as the study of Gharemani, Karami, and Balcean (2017), which was titled "The Five-Habit Design Based on the Use of the Pentagon Strategy to Develop Mind Habits Related to Thinking" in a number of schools for the gifted. The results of this study showed that teaching the program based on the Pentagon theory prompted students to collect information about issues through websites that contain geographical and historical documents as supporting data to understand the relationship between the parts of the issue, link the past to the present, and anticipate the future, thus helping them make a sound decision according to clear criteria, in addition to the existence of many studies that emphasized the development of cognitive depth, including Jackson (Jackson, 2010) and Viator (Viator, 2010).

Based on the above, the researcher believes the Pentagon strategy, when used in educational media, enhances students' cognitive efficiency and knowledge production by providing them with new skills and information. This study highlights the importance of using multimedia-based strategies in social studies teaching to reduce reliance on traditional methods and promote cognitive depth.

The Pentagon strategy, also known as the circular pentagon, is a geometric and mathematical method used by mathematicians since 1992 (Schwartz, 1992). It was first applied to geometry, specifically the Pentagon, and has not been applied to science or social studies. The Pentagon theory seeks to integrate the rational, mechanical, and technological dimensions of knowledge within a unified framework, emphasizing intelligence, participation, imagination, problem-solving, and cognitive integration. (Ovenhouse, 2019; Dolk, Granat, 2012; Nakamori, Wierzbicki, 2012).

The importance of this strategy lies in its being a dynamic, organized system that proceeds from simple cognitive structures to more complex cognitive structures through the integration of its cognitive and methodological components. It also relies on rational dynamics related to facts, analysis, and informed decision-making (Tsuyoshi, 2016). Furthermore, the Pentagon strategy is associated with providing creative solutions to educational problems, as it activates learners' individual intuition and stimulates their imagination to arrive at unconventional solutions (Dolk & Granat, 2012).

Nakamori and Wierzbicki (2012) define it as a five-part system for integrating and creating knowledge. It is linked to the modern concept of creative space and consists of five elements: intelligence, participation, imagination, intervention, and integration, which represent five diverse basic dimensions of creative space. The meanings and roles of these dimensions in the process of integrating and creating knowledge are reviewed and analyzed, highlighting their importance in promoting creative thinking and fostering innovation.

The Pentagon strategy consists of five interconnected stages that represent integrated steps aimed at developing learners' thinking, analysis, and problem-solving skills. These stages help organize the learning process by enabling learners to actively engage with the content and gradually transition from knowledge gathering to evaluation. These stages also provide the teacher with the opportunity to systematically monitor performance at each stage, thereby enhancing the effectiveness of the educational process and linking theory to practical application. The following is a detailed overview of each stage of this strategy:

1. Knowledge:

Involves gathering information and data relevant to the topic or problem.

2. Planning:

Involves developing a detailed action plan based on the gathered information.

3. Decision-making:

Involves selecting the best possible solutions from among the available options.

#### 4. Implementation:

Involves implementing the plan and monitoring the progress of the work.

#### 5. Evaluation:

Involves evaluating results, determining the extent to which the desired goals have been achieved, and identifying the strengths and weaknesses of the process (Abdelmagied, 2025).

The researcher believes that the Pentagon strategy constitutes an integrated and effective framework for developing learners' higher-order thinking skills. Each of its five stages contributes to building an organized learning process that begins with establishing knowledge and ends with evaluating results and expanding applications. The knowledge stage provides learners with a comprehensive understanding of the task, the planning stage enables them to organize information and develop clear strategies, while the decision-making stage provides vital skills for making sound choices in the context of problem-solving. During the application stage, ideas are transformed into actions through practical activities that promote active and experiential learning. The evaluation stage enhances learners' awareness of their achievements and helps them improve their future performance. Accordingly, the researcher believes that applying this model facilitates integration between theoretical knowledge and practical skills, contributing to the preparation of learners who are capable of facing educational and life challenges with efficiency and flexibility.

Glick, Pylyavskyy (2016) noted that the Pentagon strategy has several characteristics that make it suitable for use in multimedia-based educational environments, particularly in the field of social studies. These characteristics include:

1. Continuity is maintained by monitoring changes in stages and making appropriate corrective adjustments as needed.
2. Flexibility, which allows for adaptation to different educational situations without adhering to a rigid sequence of steps.
3. Integration, whereby mastery of each step depends on the quality of implementation of the others, enhances the coherence of students' cognitive construction.
4. Interface, whereby any change in one stage is reflected in the remaining stages.
5. Systematic organization, which begins with identifying inputs and proceeds through a series of processes to arrive at scalable and evaluable outputs.
6. Dynamism, which is one of its most prominent features, as the strategy progresses from simple concepts to complex cognitive concepts, supporting the development of cognitive depth among students.

It is clear that the Pentagon strategy (the five-fold knowledge system) is based on five main cognitive dimensions, which together form an interconnected system that contributes to generating knowledge and solving problems. These dimensions are (Dolk & Granat, 2012):

First: The intervention dimension

This refers to taking effective action toward a problem that has not been addressed before. This dimension begins by posing fundamental questions, such as: What type of knowledge is required to address the problem? This requires utilizing other dimensions to systematically gather the necessary knowledge, allowing the problem to be approached from a new perspective.

Second: The dimension of mental acumen (intelligence).

This dimension represents enhancing an individual's ability to understand and learn by collecting relevant data and information, analyzing them systematically, and then employing them to build a

model for investigation, simulation, or improvement. This dimension is the basis for understanding phenomena and making informed decisions.

Third: The dimension of imagination.

This dimension relates to generating creative ideas about new or familiar phenomena and simulating them in a way that fosters a deep understanding of them, based on available information, even if partial. This dimension also contributes to transcending the boundaries of familiar reality by generating new perceptions using contemporary technologies.

Fourth: The dimension of interaction (participation).

This dimension focuses on stimulating personal passion and motivating others to actively participate. Various tools and methods are used to gather opinions and interact, such as interviews and questionnaires, with the aim of diversifying knowledge sources and enhancing collective understanding.

Fifth: The dimension of integration.

This dimension means integrating different types of knowledge, even if heterogeneous, within a unified system, in a way that enables verification of the accuracy of results and the validity of the resulting outputs. The previous dimensions. This integration is a prerequisite for building coherent knowledge.

As Al-Gabry, Kamal Eldin, and Abdel Dayem (2023) defined, the dimensions of the Pentagon strategy are defined within a timeframe linked to the implementation of the educational task, divided into three stages undertaken by the teacher:

- The pre-implementation stage: This stage breaks the deadlock, reflects on the nature of the task, stimulates thinking through brainstorming, motivates learners, and fosters a spirit of challenge among them.
- The implementation stage involves the use of narrative methods, such as proverbs and meaningful stories, effective time management, and the provision of motivational phrases that encourage students to interact and engage in the activity.
- The post-implementation stage: The classroom is transformed into an interactive environment that fosters dialogue and presents diverse viewpoints. Students are encouraged to use the strategy as a life skill, and the most important lessons learned are summarized, enhancing achievement of the desired goals.

In the researcher's opinion, the dimensions of the Pentagon system constitute an integrative framework that contributes to knowledge construction through multiple stages, beginning with intervention and ending with integration. This reflects the comprehensiveness of the approach to addressing problems. These dimensions highlight the importance of the interaction between rational and emotional thinking in producing effective knowledge.

The learning process is characterized by a diversity of approaches, each representing a different stage of educational interaction. The rapid advances in information and communications technology have contributed to a radical transformation, expanding the scope of educational uses and the emergence of innovative methods that enhance the efficiency of this educational model. Among the most prominent approaches that have proven effective is multimedia, which relies on integrating written materials with audio-visual media, such as educational recordings delivered via disks (floppy or compact discs), telephone calls, or radio and television broadcasts. Printed materials remain the cornerstone of distance learning curricula, forming the primary platform upon which other educational services and systems are built. These materials take various forms, including academic

references, study guides, and textbooks, carefully designed to meet the needs of learners at various levels (Abdullahi, Amao, Abubakar, 2024). Accordingly, it can be said that technology has brought about a radical transformation in educational systems. It is no longer limited to being a mere aid, but has become an essential component in designing and developing curricula and delivering educational content in innovative and new ways that keep pace with modern requirements and meet the diverse needs of students. Technological innovations have contributed to the development of educational activities in terms of efficiency and productivity. The use of these innovations within the educational environment effectively contributes to improving the quality of learning, providing students with greater opportunities to achieve effective educational outcomes. They also support those responsible for designing educational activities by providing tools that help them complete tasks with high quality and in less time. Technological tools are distinguished by their ability to store, preserve, and process data and information, as well as present them in attractive ways that enrich the learning experience and contribute to raising the efficiency of training and the accuracy of acquiring the modern skills required by specialists in educational activities to facilitate their job duties (Kalyani, 2024).

One of the most prominent of these technological innovations is multimedia, which is an effective tool for enhancing the educational process. Multimedia consists of two English words: "Multi" and "Media." Putra (2018) defines it as a combination of text, images, sound, animation, and video clips, some or all of which are combined within an integrated program controlled by a computer through innovative and engaging interactive programs.

#### Multimedia in Education: Key Features and Benefits

- **Interactivity:** Enhances active participation and motivation to continue learning.
- **Integration:** Combines text, images, sound, video clips, and animation for a unified educational experience.
- **Considering Individual Differences:** This approach allows for content adaptation to suit the pace and abilities of individual learners.
- **Diversity:** Presents content in various media, attracting the attention of learners with different learning styles.
- **Availability:** Enables continuous learning by providing educational opportunities for all groups, including those with special needs and those living in remote areas.
- **Digital Conversion:** Facilitates access, saves costs, and maintains quality over time.
- **Synchronization:** Provides real-time learning capabilities through tools like live streaming or virtual classrooms.
- **Flexibility:** Allows learners to adjust presentation order, choose a topic, or rewatch specific sections (UNESCO, 2002; Heinich et al., 2002).

The researcher finds that the view of the learning process has undergone a fundamental shift, from focusing on cramming students' minds with information for memorization and retrieval in traditional tests, to viewing learning as a means of preparing the individual for life, whereby they become capable of transferring acquired knowledge and skills to new situations and employing them in diverse life contexts. Attention has also shifted from simply measuring performance through achievement scores to assessing how students apply what they have learned, expanding the scope of learning beyond the walls of the classroom to become an ongoing process that accompanies the individual throughout their lives, helping them face daily challenges.

This is achieved through deep learning based on conscious understanding and critical analysis, enabling students to absorb information deeply, critique it, and employ it effectively based on their prior knowledge and experiences. In this context, Webb (1997) presented his four-pronged model of depth of knowledge, emphasizing the importance of integrating educational standards and assessment processes so that student performance is not evaluated in isolation from educational objectives, the content provided, and the established criteria.

The concept of cognitive depth refers to a learner's ability to fully and deeply comprehend concepts and information, enabling them to apply these understandings to new and complex situations, rather than merely memorizing them superficially. This concept is essential to educational processes that aim to achieve critical and analytical understanding in the learner, distinguishing it from traditional methods that focus solely on memorization (Anderson & Krathwohl, 2001).

Webb (2002) defines cognitive depth as an educational approach that requires teachers to clarify the intellectual level at which students' learning is built, reflect this depth in their teaching practices, clearly define learning objectives related to long-term needs, and evaluate students based on their comprehension of essential information that remains with them for life.

Hess (2006) believes that cognitive depth involves the critical analysis of new concepts and information, as well as the conscious connection of these concepts to the student's prior knowledge structure, thereby creating a network of connections between ideas. This definition also focuses on the student's quest to understand the meaning behind phenomena, focusing on the essential evidence, underlying principles, and concepts necessary to develop effective solutions to the challenges or problems presented.

Webb (1997) defined it as the level of cognitive complexity required by a particular performance from the learner, dividing it into four levels, ranging from simple retrieval to complex strategic thinking. Martin, Marshall (2005) argue that cognitive depth is not related to the quantity of knowledge, but rather to how it is organized, applied, and connected to new contexts.

The researcher defined cognitive depth as moving beyond memorization and superficial recall to deeper levels of analysis, association, synthesis, application, and evaluation. The importance of developing cognitive depth is evident in light of the shift towards educational systems that focus on competencies and 21st-century skills. Acquiring information is no longer sufficient; rather, it is necessary to critique, analyze, and reconstruct it. Fullan (2013) noted that deep learning necessitates an interactive learning environment that encourages students to question, analyze, and connect concepts in various ways. Darling-Hammond and colleagues (Darling-Hammond, Flook, Barron, Osher, 2019) also explained that cognitive depth represents the core of the reflective thinking that learners need to address complex real-world problems, making the impact of learning deeper and more relevant to life.

Developing cognitive depth requires adopting an educational design that goes beyond providing ready-made knowledge and is based on teaching models that stimulate higher-order thinking. Prominent among these models are problem-based learning, project-based learning, and inquiry-based learning, all of which have proven effective in developing learners' analytical and critical skills (Darling-Hammond et al., 2019). It also requires integrating content knowledge with teaching strategies that focus on questioning, formulating hypotheses, and providing reflective feedback, which strengthens the relationship between cognitive depth and the cognitive design of learning. Developing cognitive depth is closely tied to the teacher's ability to guide students' thinking toward higher levels of performance by using open-ended questions, presenting multiple representations of concepts, and connecting learning to everyday life experiences. Research by Hattie (2012) indicates that structured cognitive challenge is one of the most important factors influencing deep learning, provided it is accompanied by cognitive support and clear-thinking strategies. Learning environments

rich in interaction and diversity offer greater opportunities for reflection, interpretation, and reconstructing knowledge, contributing to the formation of interconnected and flexible knowledge networks among learners.

Cognitive depth is not an independent educational goal; rather, it is a natural outcome of the integration of objectives, content, activities, and assessment methods within a holistic conception of learning. Recent studies (Zhao, 2021) indicate that depth of knowledge does not develop in environments that rely on traditional tests or isolated content. Rather, it requires open-ended performance tasks, realistic projects, and collaborative learning that allow learners to build on the ideas of others, analyze patterns, and expand their thinking horizons.

The levels of cognitive depth are an important framework for understanding how learners' thinking skills develop. By moving between these levels, learners acquire diverse cognitive abilities that enable them to effectively deal with different information and learning situations. Among the most important of these levels, as indicated by Hess (2013), are:

Cognitive depth begins with the first level, which is recall and memorization, where the learner is asked to retrieve direct information such as facts, terms, rules, or steps. This level does not involve any type of analysis or application; rather, it focuses on memory and recall. This type of knowledge is essential, but it represents the lowest level of thinking. Anderson and Krathwohl (2001) noted in their review of Bloom's Taxonomy that this type of thinking falls within the lower levels of the cognitive domain and is necessary, but not sufficient, for deep learning.

Learning then moves to the application level, where the learner is required to use knowledge or skills in new or semi-new situations. This level is not limited to understanding but extends to the practical implementation of concepts. The learner is expected to apply specific procedures or strategies to solve problems or perform tasks. This type of depth is classified as an intermediate level in the modified Bloom's Taxonomy, representing a transitional stage between understanding and analysis. Marzano and Kendall (2006) also emphasized in their model that application is key to transferring learning from theoretical to practical realities.

Strategic thinking represents a higher level of cognitive processing, requiring learners to make informed decisions, analyze alternatives, and apply logical skills to solve complex problems. This level goes beyond simple implementation to advance planning, anticipating outcomes, and evaluating hypotheses. Costa and Kallick (2000) emphasized the importance of this type of thinking within what they refer to as "habits of mind," which are crucial for success in both academic and professional fields. Strategic thinking is linked to reflection and mental flexibility in the face of challenges. Cognitive depth reaches its highest level in extended thinking, which requires the complex and long-term application of knowledge and skills in intricate tasks, including the investigation, design, or integration of multiple knowledge domains. This level requires the learner to synthesize disparate concepts, devise new solutions, and evaluate ideas or situations from a comprehensive perspective. According to Erickson (2007), this type of thinking embodies the essence of understanding-based education, as it contributes to developing the ability to tackle open-ended problems, fosters independent thinking, and connects diverse contexts. The researcher believes that cognitive depth can be enhanced through the Pentagon strategy, which focuses on five integrated dimensions: critical thinking, which is linked to Webb's level of analysis; creativity, which is linked to the level of extended thinking; collaboration, which deepens understanding through dialogue; communication, which consolidates knowledge through expression; and cognitive integration, which links knowledge to application. Thus, the Pentagon strategy provides a comprehensive framework for integrating the levels of cognitive depth and effective educational practices, thereby enhancing student engagement and reducing distractions. This integration between Webb's cognitive depth model and the Pentagon strategy demonstrates that effective learning depends not only on the accumulation

of information but also on how it is processed and employed in diverse contexts. This calls for adopting educational curricula that promote these dimensions in a balanced manner to ensure deep and sustainable learning.

Cognitive depth is also linked to promoting active and interactive learning, as it encourages learners to engage actively with the curriculum through activities that stimulate independent thinking and foster constructive discussion. This type of learning increases learners' intrinsic motivation and develops problem-solving skills, which are among the most important goals of modern education (Bransford, Brown, Cocking, 2000). Furthermore, achieving cognitive depth requires a stimulating learning environment characterized by questioning and constructive criticism. Learners need incentives that motivate them to explore information in-depth and challenge prevailing assumptions, which is difficult to achieve in traditional educational environments that rely on rote learning and memorization (Facione, 2015).

Ultimately, cognitive depth contributes to the development of learners' social and emotional skills, as it encourages collaborative work and systematic thinking, enabling them to address real-life challenges with greater maturity and comprehensive analytical skills (Costa & Kallick, 2008).

According to the researcher, the sequence of levels of cognitive depth suggests that effective learning is not limited to memorization and recall, but rather requires a gradual transition to higher levels of thinking, such as application, analysis, and the use of complex cognitive strategies. Enhancing these levels contributes to deep and sustainable learning, especially when extended thinking is employed in educational situations that require creativity and problem-solving. Cognitive depth forms the foundation upon which self-directed learning is built, enhancing the learner's ability to deeply comprehend concepts and independently understand the relationships between them. Self-directed learning requires the individual to move between different levels of thinking, allowing them to develop analytical, evaluation, and innovation skills that support their effective and sustainable acquisition of knowledge outside the framework of traditional education.

The current study examines the effectiveness of employing a multimedia-based pentagram strategy in teaching social studies to develop students' cognitive depth at a girls' school in Jordan. This study is compared with relevant literature on the same topic. The current study represents a qualitative scientific addition, presenting an applied model that combines an educational strategy based on organizing, analyzing, and applying knowledge with supporting technological tools that contribute to improving the educational process. It addresses a topic that requires diversifying its presentation methods to enhance interaction and deepen students' understanding. This innovative approach combines a thinking-based teaching method with a technological tool, contributing to bridging a research gap in this topic. Although the study aims to investigate the impact of implementing the strategy on deeper educational and cognitive dimensions, it reflects the modern educational philosophy that focuses on constructing meaning and motivating learners to be active partners in the learning process.

## 2. Literature Review

Gharemani, Karami, and Balcean's (2017) study titled "The Five-Habit Design Based on the Use of Pentagon Theory to Develop Habits of Mind Related to Critical Thinking in Several Gifted Schools in Iran" aimed to investigate Iranian science teachers' perceptions of mind habits and the effectiveness of using Pentagon in developing them and critical thinking. This study employed a quantitative approach, adopting a descriptive methodology. The research tools consisted of a classroom observation scale and structured interviews with science teachers and experts. The sample consisted of (27) male and female teachers in gifted classes. The results demonstrated that the use of modern technology, combined with the Pentagon, led to the development of critical thinking among gifted students in the targeted classes.

The study by Adel and Ibrahim (2021) aimed to investigate the impact of the pentagram strategy on the academic achievement of fifth-grade female students in chemistry at Al-Huda Girls' Secondary School, affiliated with the Baghdad Education Directorate, Al-Rusafa II. The experimental design with partial control was chosen for the two groups. The study tool was represented by an achievement test, which was administered to a study sample of 50 female students. The results of this study showed that the students in the experimental group, who studied using the pentagram strategy, outperformed the students in the control group, who studied in the usual way, on the achievement test.

Al-Hadidi's study (2021) aimed to investigate the effectiveness of a program based on the Pentagram theory in developing societal scientific reasoning and global citizen personality among science teacher students at Alexandria University's Faculty of Education. The study employed a descriptive approach and a quasi-experimental design with a single group. The study utilized tools such as a societal scientific reasoning test and a global citizen personality scale, applying them to a sample of 50 male and female student teachers. The results indicated the effectiveness of the proposed program in developing societal scientific reasoning and global citizen personality.

Zaki, Zangan (2023). The study investigates the impact of the pentagram on the chemistry achievement of second-year intermediate students at Al-Sadir School in Baghdad. The sample consisted of 53 female students, divided into two groups: 27 students using the pentagram strategy and 26 students who studied conventionally. Factors such as chronological age, previous science achievements, and the Raven test were used to analyze the results.

The study by Bilel and Abboud (2023) aimed to investigate the impact of the Pentagram and Innovative Matrix strategies on the acquisition of geomorphological concepts among students in the Geography Department, College of Education, University of Babylon. The experimental method was adopted using the concept acquisition test on a sample consisting of 44 male and female students. The results showed a statistically significant difference between the average scores of the two groups in the research sample for the concept acquisition test, favoring the experimental group that studied using the Pentagram strategy.

Mohsen's (2021) research aims to prepare a training program based on the Pentagram strategy to develop female students' skills in scientific research. The study assumes a statistically significant difference between the average ranks of the experimental group students in pre- and post-applications on the scientific research skills observation card. The research assumes the presence of a statistically significant difference at the level ( $\alpha \leq 0.05$ ) between the average ranks of the scores of the experimental group students in the pre- and post-applications on the scientific research skills observation card (as a whole) and for each of its skills. One of the most important results of the research is the confirmation of the hypothesis, as there is a statistically significant difference at the level ( $\alpha \leq 0.05$ ) between the average ranks of the scores of the experimental group students in the pre- and post-applications on the observation card. Scientific research skills (as a whole) and each skill. The research also recommends that university education curricula should include research applications to consolidate scientific research skills.

The study by Al-Asadi and Al-Fatlawi (2023) aimed to investigate the impact of the Pentagram strategy on deep comprehension among fifth-grade students of the Arabic language textbook in Iraq, at the University of Babylon, College of Basic Education. The experimental approach was employed, and the study tools included a test of deep comprehension skills, which was administered to a sample of 61 students. The results of this study showed that students in the experimental group, who were taught using the Pentagram strategy, outperformed students in the control group, who were taught using the traditional method, in the post-test.

Although previous studies have addressed the topic of pentagram strategy and its measurement in multiple aspects, variables, and diverse educational contexts, such as the study by Gharemani, Karami, and Balcean (2017), which addressed critical thinking like the current study, and the study by Adel and Ibrahim (2021), which addressed achievement but applied it to chemistry, and Al-Hadidi's study (2021), which addressed the topic of pentagram strategy in citizenship, as for the study by Zaki and Zangan (2023), which addressed the topic of the pentagram strategy in measuring achievement in chemistry, and the study by Bilel and Abboud (2023), which addressed the topic of pentagram strategy in including concepts in geography, and Mohsen's study (2021), which addressed the topic of pentagram strategy in measuring research skills, and the study by Al-Asadi and Al-Fatlawi (2023), which applied pentagram strategy to the impact of language, most studies focused on limited aspects such as academic achievement. Incorporating concepts or developing thinking in general terms is rare. Studies examining the impact of the pentagram strategy on developing cognitive depth, specifically within the researcher's knowledge, are rare, particularly in social studies subjects and on the subject of Islamic civilization, which the study applied to in the textbook. Furthermore, most studies did not integrate multimedia support into the implementation of the strategy, which is considered innovative in the current context. Hence, this study aims to fill the gap by examining the development of cognitive depth based on the pentagram strategy among female students.

In summary, the current study reviewed the literature on pentagrams in education, identifying similarities with the current study, and represents a qualitative scientific addition, presenting an applied model that combines an educational strategy based on organizing, analyzing, and applying knowledge with supporting technological tools that contribute to improving the educational process. It addresses a subject that requires diversifying its presentation methods to enhance interaction and achieve a deeper understanding among students. This innovative approach combines a thinking-based teaching method with a technological tool, bridging a research gap in the subject. The study aimed to investigate the impact of implementing this strategy on deeper educational and cognitive dimensions, reflecting the modern philosophy of education that emphasizes constructing meaning and motivating learners to be active partners in the learning process.

### **3. Methodology**

#### **3.1. Methods and Procedures**

This chapter discusses the study methodology, the method used to conduct the study, and the identification of the study sample. It also includes the tools used to collect and analyze data, explaining how to verify their validity and reliability. Furthermore, it reviews the tools used in the study to ensure their accuracy and reliability. The main variables studied are also reviewed, explaining how to process the data using appropriate statistical methods to provide accurate answers to the research questions, which contribute to a scientific and systematic analysis of the results.

To verify the effectiveness of employing the Multimedia-Supported Pentagram Strategy on developing Cognitive Depth in Social Studies, a quasi-experimental approach was adopted. This was due to the inability to implement a traditional experimental design, which requires random assignment of participants to an experimental and control group. This was due to the nature of the educational environment in which the study was conducted, as it dealt with pre-existing classes at the school, making random assignment impossible. Accordingly, one class was assigned as an experimental group, and the other as a control group (Shadish et al., 2002). Study Individuals

An experimental group and a control group, consisting of 38 seventh-grade female students from the Bani Obaid Education Directorate, were intentionally selected from Jawharat Al-Manara School due to the availability of the internet within the school and the cooperation of the school and the teacher with the researcher. Two seventh-grade classes were randomly selected: the experimental group, which studied the educational unit from the seventh-grade social studies book using the

multimedia-based Pentagon strategy, and which consisted of (19) students; and the control group, which studied using the traditional method and which included (19) students.

**Justification for Selecting the Sample:** The study was limited to seventh-grade female students due to the collaborative learning environment provided by the Jawharat Al-Manara Girls' School, its compatibility with the Islamic Civilization curriculum, and the school's possession of the necessary equipment and internet access to integrate multimedia. Although limiting the sample to female students may make it difficult to extrapolate the results to all students, it provides a basis for future research.

### **3.2. Study Material and Tools**

The study material consisted of a teacher's guide based on the multimedia-based Pentagon strategy for teaching the lessons of Unit Eleven (Islamic Civilization) in the Social Studies subject for seventh-grade students in the second semester of the 2024-2025 academic year. It was prepared according to the following steps:

1. Review educational literature and previous studies related to the Pentagon strategy to familiarize yourself with it and the steps for implementing this strategy in educational situations.
2. Review some teacher guides in Jordan to familiarize yourself with the general framework of educational guides.
3. Identify the target group (seventh-grade female students) and the subject (social studies).
4. Select Unit Eleven from the seventh-grade Social Studies textbook under the title "Islamic Civilization."
5. The researcher carefully reviewed the content of the study unit (the lessons included, the methods used, the unit objectives, the thinking methods, the images, and the maps) to develop a scenario for using the Pentagon strategy, as well as design the necessary activities and exercises.
6. Arrived at the general framework for the teacher's guide.
7. The guide was prepared in two parts. The first is the theoretical framework, which includes an introduction and definition of the Pentagon strategy and its stages, an explanation of the concept of cognitive depth for those who benefit from the guide, procedures for implementing the Pentagon strategy guide, procedural steps for explaining the educational unit using the Pentagon strategy, an explanation of the teacher's role and requirements, important guidelines for students, and the educational tools used.
8. The practical part of the guide includes:
  - Developing a timeline for teaching the content topics, in accordance with the timeline specified by the Ministry of Education for teaching those topics.
  - General outcomes of the study unit.

Organizing the introduction and scientific content of the subject, the general objectives of the unit, teaching aids, activities, necessary materials, and assessment methods.

- Various outcomes were formulated for each lesson (cognitive, affective, and skill-based), and the tools used were identified (documents, images, video clips, colors, cartoons, maps, virtual tours, cards, worksheets). The procedures for implementing each lesson were detailed, as were teaching strategies and various activities that contribute to developing students' skills. Assessment tools were used to measure student performance, and tests were administered using Wordwall.

- Using educational videos related to the unit topics on YouTube and PowerPoint slides, and designing images using Canva.

9. Developing the guide in its initial form.

### **3.3. Validation of the Teacher's Guide**

The Teacher's Guide was presented to a group of experienced and specialized judges in curricula and teaching methods for the Social Studies subject, as well as to a group of 10 educational supervisors. They were asked to express their opinions on the suitability of the lesson plan for the Pentagram strategy, the clarity, accuracy, and integrity of the educational material provided in the guide, and the suitability of the student learning activities. This was done to determine its validity and modify it in light of their opinions. The paragraphs indicated by the judges were reworded and modified. Images of cultural achievements,, such as the Umayyad Mosque and Qasr Amra,, were added. Additionally, some images designed using the Canva application that were similar to other images, like the image of the Battle of Yarmouk, were removed. Some activities, such as the hat activity, were added to the guide in its final form.

### **3.4. Study Tools**

#### **First: Cognitive Depth Test**

To achieve the study objectives, the cognitive depth skills that the study sought to improve among the study sample were first identified. This was achieved by referencing the seventh-grade social studies textbook, the general framework and specific outcomes of the social studies curriculum in Jordan (2013), as well as previous studies. In light of this, these skills were identified: memory, application, extended thinking, and strategic thinking.

The cognitive depth test was then determined to measure the level of cognitive depth skills among the study sample before and after the experiment. The final version of the test consisted of (20) items distributed equally across the four skills, with the score calculated out of (20): memory (5) points, application (5) points, extended thinking (5) points, and strategic thinking (5) points.

#### **Test Validity**

The validity of the test was verified by presenting it to (10) arbitrators from among the faculty members of Jordanian universities, educational supervisors, and teachers who teach social studies. They were asked to express their opinions on the cognitive depth tool and skills, the clarity of the questions, and their measurement of cognitive depth. They also took notes on the test items to ensure the validity of the test, the scientific and linguistic accuracy of its items, the wording of the sentences and paragraphs, their suitability for the age group covered by the study, the degree to which the items relate to the unit topics and the level of the students, and the appropriateness of the alternatives for the test items. In light of the arbitrators' feedback, the linguistic wording of some items was modified, some alternatives were replaced, and some answer options were modified by eliminating the option (all of the above). The researcher relied on the consensus of 80% of the arbitrators until the test reached its final form, Appendix I. Construct Validity.

To verify the construct validity of the cognitive depth test, it was applied to a pilot sample of 20 female students from the study community and from outside the study population. Pearson's correlation coefficient was calculated between the item score and the total skill score, and between the item score and the total test score. Table 1 illustrates this.

**Table 1.** Construct Validity Indicators for the Cognitive Depth Test

| field                    | Paragraph | Pearson's correlation coefficient between the item score and the total skill score | Pearson's correlation coefficient between the item score and the total test score |
|--------------------------|-----------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| memory skill             | 1         | .932**                                                                             | .873**                                                                            |
|                          | 2         | .932**                                                                             | .873**                                                                            |
|                          | 3         | .760**                                                                             | .658**                                                                            |
|                          | 4         | .708**                                                                             | .744**                                                                            |
|                          | 5         | .666**                                                                             | .648**                                                                            |
| Application skill        | 6         | .838**                                                                             | .794**                                                                            |
|                          | 7         | .838**                                                                             | .794**                                                                            |
|                          | 8         | .860**                                                                             | .750**                                                                            |
|                          | 9         | .773**                                                                             | .660**                                                                            |
|                          | 10        | .754**                                                                             | .551*                                                                             |
| Extended thinking skill  | 11        | .889**                                                                             | .804**                                                                            |
|                          | 12        | .889**                                                                             | .898**                                                                            |
|                          | 13        | .773**                                                                             | .615**                                                                            |
|                          | 14        | .637**                                                                             | .779**                                                                            |
|                          | 15        | .603**                                                                             | .479*                                                                             |
| Strategic thinking skill | 16        | .742**                                                                             | .773**                                                                            |
|                          | 17        | .587**                                                                             | .615**                                                                            |
|                          | 18        | .804**                                                                             | .734**                                                                            |
|                          | 19        | .690**                                                                             | .566*                                                                             |
|                          | 20        | .811**                                                                             | .744**                                                                            |

It is noted from Table 1 that all correlation coefficients are statistically significant at the significance level  $\alpha = 0.05$ , and all correlation coefficients (Pearson) are higher than the cut-off mark (0.30), which indicates the validity of the cognitive depth test (Al-Kilani & Al-Sharifain, 2016).

### Test Reliability

To verify the reliability of the cognitive depth test, Cronbach's alpha coefficients (internal consistency) were calculated for the four skills and for the test as a whole. Table (2) shows this:

**Table 2.** Indicators of the Reliability of the Cognitive Depth Test

| field                    | Cronbach's alpha |
|--------------------------|------------------|
| Memory skill             | 0.857            |
| Application skill        | 0.871            |
| Extensive thinking skill | 0.813            |
| Strategic thinking skill | 0.774            |
| Total                    | 0.950            |

Table (2) shows that the internal consistency coefficient (Cronbach's alpha) for the field of memory skill (0.857), for the field of application skill (0.871), for the field of extended thinking skill (0.813), for the field of strategic thinking skill (0.774), and (0.950) for the total scale, and all of them are higher than the cut-off mark (0.70). This indicates the stability of the cognitive depth test (Kizlik, 2012).

### Equivalence of the Two Study Groups

The equivalence of the two study groups (experimental and control) in terms of cognitive depth skills, both individually and collectively, was tested using an independent samples t-test. Ensuring the equivalence of the groups before applying the treatment is a key factor in enhancing the internal validity of the study. It allows subsequent statistical differences to be attributed to the experimental intervention itself, without the potential influence of external variables or group differences (Shadish et al., 2002). Table 3 illustrates this.

**Table 3.** Results of the T-Test to Detect the Equivalence of the Two Study Groups in Pre-Performance On Cognitive Depth Skills, Individually and Collectively.

| Dependent Variable              | Group              | Arithmetic mean | Standard deviation | t-test | Degrees of freedom | Statistical significance |
|---------------------------------|--------------------|-----------------|--------------------|--------|--------------------|--------------------------|
| Remembering Skill               | Control group      | 2.0000          | .74536             | .195   | 36                 | .847                     |
|                                 | Experimental group | 1.9474          | .91127             |        |                    |                          |
| Application Skill               | Control group      | 2.0526          | .91127             | .545   | 36                 | .589                     |
|                                 | Experimental group | 1.8947          | .87526             |        |                    |                          |
| Extended Thinking Skill         | Control group      | 1.5789          | .76853             | -.798- | 36                 | .430                     |
|                                 | Experimental group | 1.7895          | .85498             |        |                    |                          |
| Strategic Thinking Skill        | Control group      | 1.7368          | .93346             | .730   | 36                 | .470                     |
|                                 | Experimental group | 1.5263          | .84119             |        |                    |                          |
| Overall (Cognitive Depth Score) | Control group      | 7.3684          | 1.53516            | .384   | 36                 | .703                     |
|                                 | Experimental group | 7.1579          | 1.83373            |        |                    |                          |

It is noted from Table 3 that there is no statistically significant difference between the average performance of the two study groups in terms of skills and cognitive depth, either individually or in combination. This indicates that the two groups were statistically equivalent prior to the treatment being carried out.

### 3.5. Study Implementation Procedures

To achieve the study objectives, the following procedures were implemented:

- A review of educational literature and previous studies related to the Pentagon strategy, multimedia, and cognitive depth was conducted. The researcher verified the availability of theoretical literature and studies that could be utilized during the study's implementation, and ensured that no

previous studies had examined the same topic (the Pentagon strategy based on multimedia in developing cognitive depth).

- Defining the study's problem and questions.
- Defining the educational material that serves the Pentagon strategy within the seventh-grade social studies textbook. The unit "Islamic Civilization" was selected, comprising five lessons: the first, "The Era of the Rightly-Guided Caliphs," the second, "The Umayyad State: Origins and Expansion," the third, "Civilizational Achievements," the fourth, "The End of the Umayyad State," and the fifth, "Primary and Secondary Historical Sources."
- The school in which the study was implemented was intentionally selected, and preliminary approval was obtained from the history teacher and the school principal.
- Preparing a teacher's guide for teaching the "Islamic Civilization" unit based on the Pentagon strategy, and ensuring its validity.
- Developing study tools for the Islamic Civilization Unit (Cognitive Depth Test) in their initial form.
- Presenting the study tools to a number of expert referees, taking their comments into account, and making suggested amendments.
- Preparing the Cognitive Depth Test in its final form.
- Obtaining a task facilitation letter from Yarmouk University to the Bani Ubaid District Directorate in Irbid to facilitate the researcher's task in conducting the study from March 11, 2025, to April 1, 2025.
- Obtaining a task facilitation letter from the Bani Ubaid District Education Directorate to Jawharat Al-Manara Secondary School for implementing the study.
- Two 60-minute training and empowerment sessions were held for the history teacher who implemented the Pentagon strategy, to enable her to use the Pentagon strategy through the teacher's guide. Training times were chosen to accommodate the teachers' and researchers' free time.
- Two study sample groups (the experimental and control groups) were intentionally selected from the Jawharat Al-Manara School in Bani Ubaid District.
- Design a timetable for teaching the study unit.
- Apply the tools to a pilot sample from within the study community and outside of it to verify the validity and reliability of the tools, as well as the appropriateness of the proposed timeframe for implementation.
- Pre-apply the tools (cognitive depth test) to the two groups (experimental and control) to ensure equivalence and control for the impact of their pre-performance.
- Teach the experimental group according to the Pentagon (PG) strategy, and the control group according to the traditional method, for a period of three weeks, extending from March 11, 2025, to April 1, 2025, with 10 sessions.
- Apply the tools post-application (cognitive depth test) to the two groups (experimental and control), with the last session of the application scheduled for April 1, 2025.
- Intensive follow-up by the researcher during the application process to ensure adherence to the guidelines for the experimental group and the use of the traditional method for the control group.

- Correcting the test papers after completing the educational material for both groups, organizing the data, and then analyzing it using appropriate statistical processing and the Statistical Package for Social Sciences (SPSS) program to answer the study questions.
- Analyzing, interpreting, and discussing the results in light of the study findings by the researcher.
- Providing recommendations and suggestions based on the results obtained to improve cognitive depth skills.

### ***3.6.1. The Potential Effects of Researcher-Teacher Interaction On the Process***

It's essential to consider that the teacher's adherence to the teacher's guide and the researcher's commitment to overseeing implementation may both be influenced by the interactions between the two parties during program implementation. Before the program began, the teacher attended two training sessions to ensure she fully understood the pentagram strategy's teaching procedures, in order to minimize the impact of this interaction. Additionally, the researcher made sure that during the lessons, his role was supervisory rather than interventionist. It is still possible, though, that the results might have been affected by the teacher's extra zeal or awareness of the researcher's involvement.

### ***3.6.2. Limitations***

It is worth noting that the study has several limitations.

1. Only female students in the 17th grade were included in the sample, which might limit the findings' applicability to male students or students in other grade levels.
2. The results may not accurately represent the efficacy of the Pentagram strategy in other units or subjects, as the intervention was limited to Unit Eleven (Islamic Civilization) of the Social Studies textbook.
3. The study was conducted in the second semester of the 2024–2025 school year, which may have influenced the degree of student participation and learning outcomes.

Finally, although experts reviewed and validated the teacher's guide and assessment tools, they may need to be further refined and modified for broader use in various educational contexts.

### ***3.7. Variables of the Study***

The study included the following variables:

Independent variable: teaching strategy, which has two strategic categories (pentagram (PG) and conventional).

Dependent variable: cognitive depth.

### ***3.8. Design of the Study***

The study design can be expressed in the following diagram:

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| EG | O1 | O2 | X1 | O1 | O2 |
| CG | O1 | O2 | X0 | O1 | O2 |

EG: Experimental group.

CG: Control group.

X1: Experimental treatment (Pentagram strategy).

X0: Conventional method.

O1: Cognitive depth test (pre- and post-test).

### 3.9. Statistical Processing

To answer the study's questions, one-way ANCOVA and one-way MANCOVA were used.

## 4. Results

The study aimed to determine the effectiveness of a multimedia-based Pentagram strategy in teaching social studies, with the goal of developing cognitive depth among seventh-grade female students in Jordan. The following is a presentation of the findings.

First: The results of the study question, which stated: Are there statistically significant differences at the significance level ( $\alpha = 0.05$ ) between the mean scores of the experimental group and the mean scores of the control group on the cognitive depth test attributable to the teaching method (traditional, Pentagram strategy)?

To answer this question, the arithmetic means and standard deviations of the study individuals' pre- and post-test performance on the combined cognitive depth skills were calculated according to the teaching strategy variable (pentagram, regular). Table 4 presents the results of this analysis.

**Table 4.** Arithmetic Means and Standard Deviations of the Study Individuals' Performance on Cognitive Depth Skills Combined According to the Teaching Method Variable.

| Group        | Pre-test         |                    | Post-test        |                    |
|--------------|------------------|--------------------|------------------|--------------------|
|              | Arithmetic mean* | Standard deviation | Arithmetic mean* | Standard deviation |
| Control      | 7.3684           | 1.53516            | 13.0526          | 1.92855            |
| Experimental | 7.1579           | 1.83373            | 17.1053          | 1.14962            |
| Total        | 7.2632           | 1.67145            | 15.0789          | 2.58249            |

\*Maximum mark for cognitive depth (20)

As noted in Table 4, the study found a significant difference in the average performance of the experimental and control groups on combined cognitive depth skills after the post-test, with the experimental group achieving better results. The arithmetic mean of the control group's performance was 13.0526, while the experimental group's performance was 17.1053. To test the statistical significance of this difference, a one-way analysis of variance (One Way ANCOVA) was conducted, and Table 5 shows that:

**Table 5.** One-Way Analysis of Variance Accompanying the Statistical Significance Test of the Apparent Difference in the Study Individuals' Post-Performance On Combined Cognitive Depth Skills After Controlling for the Effect of Pre-Performance According to the Teaching Method.

| Source of Variance | Sum of Squares | Degrees of Freedom | Mean of Squares | F-Value | Statistical Significance | Eta Square (Effect Size) |
|--------------------|----------------|--------------------|-----------------|---------|--------------------------|--------------------------|
| Pre-performance    | 2.095          | 1                  | 2.095           | .827    | .369                     | .023                     |
| Teaching method    | 153.096        | 1                  | 153.096         | 60.449  | .000                     | .633                     |
| Error              | 88.642         | 35                 | 2.533           |         |                          |                          |
| Total average      | 246.763        | 37                 |                 |         |                          |                          |

It is noted from Table 5 that the study found a significant difference in performance between experimental and control groups in combined cognitive depth skills, with the experimental group explaining (0.633) of the variance. The teaching method accounted for (63.3%) of the variance, and Table 6 shows this.

**Table 6.** The Arithmetic Means, Standard Deviations, and Standard Errors of the Experimental and Control Groups in the Combined Cognitive Depth Skills Before and After Adjusting for Pre- and Post-Differences.

| Dependent Variable              | Group        | Before Adjustment |                    | After Adjustment |                    |
|---------------------------------|--------------|-------------------|--------------------|------------------|--------------------|
|                                 |              | Arithmetic mean   | Standard deviation | Arithmetic mean  | Standard deviation |
| Combined cognitive depth skills | Control      | 13.0526           | 1.92855            | 13.068           | .365               |
|                                 | Experimental | 17.1053           | 1.14962            | 17.090           | .365               |

Table 6 shows that a study found the Pentagon strategy to significantly improve cognitive depth skills in social studies among seventh-grade female students, with a significant difference between the experimental and control groups, as shown in Table 7.

**Table 7.** Arithmetic means and standard deviations of the study individuals' pre- and post-test performance on cognitive depth skills alone according to the teaching method.

| Cognitive Depth Skills    | Maximum Score | Group        | Pre-test        |                    | Post-test       |                    |
|---------------------------|---------------|--------------|-----------------|--------------------|-----------------|--------------------|
|                           |               |              | Arithmetic mean | Standard deviation | Arithmetic mean | Standard deviation |
| Memory skill              | 5             | Control      | 2.0000          | .74536             | 3.3684          | .68399             |
|                           |               | Experimental | 1.9474          | .91127             | 4.3684          | .68399             |
|                           |               | Total        | 1.9737          | .82156             | 3.8684          | .84377             |
| Application skill         | 5             | Control      | 2.0526          | .91127             | 3.3158          | .67104             |
|                           |               | Experimental | 1.8947          | .87526             | 4.2632          | .56195             |
|                           |               | Total        | 1.9737          | .88491             | 3.7895          | .77661             |
| Extensive thinking skills | 5             | Control      | 1.5789          | .76853             | 3.3684          | .59726             |
|                           |               | Experimental | 1.7895          | .85498             | 4.3684          | .76089             |
|                           |               | Total        | 1.6842          | .80891             | 3.8684          | .84377             |
| Strategic thinking skill  | 5             | Control      | 1.7368          | .93346             | 3.0000          | .81650             |
|                           |               | Experimental | 1.5263          | .84119             | 4.1053          | .73747             |
|                           |               | Total        | 1.6316          | .88290             | 3.5526          | .95003             |

It is noted from Table (7) that there are apparent differences between the arithmetic means of the performance of the experimental and control groups in the post-performance on cognitive depth skills (individually), according to the teaching method variable, in favor of the experimental group; as the average performance of the members of the experimental group reached (4.3684) in the skill of remembering, (4.2632) in the skill of application, (4.3684) in the skill of extended thinking, and (4.1053) in the skill of strategic thinking, while the average performance of the members of the control group reached (3.3684) in the skill of remembering, (3.3158) in the skill of application, (3.3684) in the skill of extended thinking, and (3.0000) in the skill of strategic thinking.

To test the statistical significance of the apparent differences in the study individuals' post-performance on the four cognitive depth skills (individually), according to the teaching method variable, after controlling for the effect of pre-performance, a one-way multivariate analysis of variance (One Way MANCOVA) was conducted, and Table 8 shows that:

**Table 8.** One-Way MANCOVA to Test the Statistical Significance of the Differences in the Study Individuals' Post-Performance on Cognitive Depth Skills (Individually) After Controlling for the Effect of Pre-Performance.

| Source of Variance           | Hotelling Tris Test Value and Significance | Cognitive Depth Skills    | Sum of Squares | Degrees of Freedom | Mean Squares | F-Statistical Value | Statistical Significance | Eta Square |
|------------------------------|--------------------------------------------|---------------------------|----------------|--------------------|--------------|---------------------|--------------------------|------------|
| Pre-memory skill             |                                            | Memory skill              | .495           | 1                  | .495         | 1.067               | .309                     | .032       |
| Pre-application skill        |                                            | Application skill         | .546           | 1                  | .546         | 1.462               | .236                     | .044       |
| Pre-extended thinking skill  |                                            | Extensive thinking skills | .910           | 1                  | .910         | 2.038               | .163                     | .060       |
| Pre-strategic thinking skill |                                            | Strategic thinking skill  | .477           | 1                  | .477         | .866                | .359                     | .026       |
| Teaching method              | F=12.924<br>Sig=0.000                      | Memory skill              | 8.262          | 1                  | 8.262        | 17.822              | .000                     | .358       |
|                              |                                            | Application skill         | 7.927          | 1                  | 7.927        | 21.234              | .000                     | .399       |
|                              |                                            | Extensive thinking skill  | 7.416          | 1                  | 7.416        | 16.607              | .000                     | .342       |

| Source of Variance | Hoteling Tris Test Value and Significance | Cognitive Depth Skills    | Sum of Squares | Degrees of Freedom | Mean Squares | F-Statistical Value | Statistical Significance | Eta Square |
|--------------------|-------------------------------------------|---------------------------|----------------|--------------------|--------------|---------------------|--------------------------|------------|
|                    |                                           | Strategic thinking skill  | 10.736         | 1                  | 10.736       | 19.463              | .000                     | .378       |
| error              |                                           | Memory skill              | 14.835         | 32                 | .464         |                     |                          |            |
|                    |                                           | Applicati on skill        | 11.946         | 32                 | .373         |                     |                          |            |
|                    |                                           | Extensive thinking skills | 14.289         | 32                 | .447         |                     |                          |            |
|                    |                                           | Strategic thinking skill  | 17.651         | 32                 | .552         |                     |                          |            |
| Total average      |                                           | Memory skill              | 26.342         | 37                 |              |                     |                          |            |
|                    |                                           | Applicati on skill        | 22.316         | 37                 |              |                     |                          |            |
|                    |                                           | Extensive thinking skill  | 26.342         | 37                 |              |                     |                          |            |
|                    |                                           | Strategic thinking skill  | 33.395         | 37                 |              |                     |                          |            |

As noted in Table 8, there are significant differences in performance between the experimental and control groups on four cognitive depth skills, with the Pentagonram teaching method explaining 35.8%, 39.9%, 34.2%, and 37.8% of the variance, respectively. The teaching method had the greatest impact on application skill, followed by strategic thinking, memory, and extended thinking. The effect size was high, exceeding 16%. To compare the average performance of the experimental and control groups on each of the four cognitive depth skills (individually), the adjusted arithmetic means, standard deviations, and standard errors were calculated according to the teaching method before and after controlling for pre- and post-differences, and Table 9 shows this:

**Table 9.** Adjusted Arithmetic Means, Standard Deviations, and Standard Errors for the Experimental and Control Groups on Each of the Four Cognitive Depth Skills (Individually) Before and After Controlling for Pre- and Post-Test Differences.

| Cognitive depth skills    | Group        | Before Editing  |                    | After Editing   |                    |
|---------------------------|--------------|-----------------|--------------------|-----------------|--------------------|
|                           |              | Arithmetic mean | Standard deviation | Arithmetic mean | Standard deviation |
| Remembering skills        | Control      | 3.3684          | .68399             | 3.390           | .158               |
|                           | Experimental | 4.3684          | .68399             | 4.346           | .158               |
| Application skills        | Control      | 3.3158          | .67104             | 3.321           | .142               |
|                           | Experimental | 4.2632          | .56195             | 4.258           | .142               |
| Extensive thinking skills | Control      | 3.3684          | .59726             | 3.416           | .155               |
|                           | Experimental | 4.3684          | .76089             | 4.321           | .155               |
| Strategic thinking skills | Control      | 3.0000          | .81650             | 3.008           | .173               |
|                           | Experimental | 4.1053          | .73747             | 4.098           | .173               |

It is noted from Table 9 that there are differences between the performance of the experimental and control groups on each of the four cognitive depth skills (individually), in favor of the experimental group. Accordingly, the educational program based on the Pentagon has a statistically significant effect in improving cognitive depth skills in social studies for seventh-grade female students.

## 5. Discussion

Educational models that involve real or quasi-realistic situations promote reflection, analysis, hypothesis generation, and alternative solution-seeking processes, fostering deeper learning that focuses on understanding and meaning. These models also engage the brain's higher executive functions, including working memory, attention, and cognitive control. Inquiry, cooperative learning, and projects are effective tools for developing multi-level thinking, motivating learners to discover relationships, generalizations, and patterns. A study found a statistically significant difference in cognitive depth test scores between experimental and control groups, with the experimental group showing better performance.

After answering the study question clearly and in detail "Are there statistically significant differences at the significance level ( $\alpha = 0.05$ ) between the mean scores of the experimental group and the mean scores of the control group on the cognitive depth test attributable to the teaching method (traditional, Pentagon strategy)?"

The results showed an apparent difference between the average performance of the experimental and control groups after the post-test on combined cognitive depth skills, in favor of the experimental group, as the arithmetic mean of the performance of the control group members after the post-test was (13.0526), while the arithmetic mean of the performance of the experimental group members was (17.1053).

Numerous studies confirm that the development of cognitive depth skills in learners is closely linked to the type of educational processing they experience. When learners are integrated into educational experiences that foster in-depth thinking and complex mental activity, their ability to

perform tasks that require analysis, interpretation, evaluation, and conceptual connections increases. This type of education seeks to reconstruct information within the learner's own cognitive structure (Zohar & Dori, 2003).

Educational models that involve real or quasi-realistic situations promote reflection, analysis, hypothesis generation, and alternative solution-seeking processes, leading to a deeper understanding and greater meaning. These models also engage the brain's higher executive functions, enhancing cognitive performance and comprehension. Inquiry, cooperative learning, and projects are effective tools for developing multi-level thinking. Developing cognitive depth is not an automatic process but a result of a systematic educational design that encourages active engagement with knowledge and provides time for reflection, application, and review. The current study also aligns with the findings of Bransford et al. (2000), Hattie (2009), Zohar & Dori (2003), and Al-Asadi & Al-Fatlawi (2023).

There was a difference in the combined cognitive depth performance between the experimental and control groups, favoring the experimental group. Accordingly, the use of the Pentagon strategy had a statistically significant effect in improving cognitive depth skills in social studies among seventh-grade female students. This improvement in the experimental group's performance is attributed to the nature of the Pentagon strategy, which focuses on using open-ended questions, enhancing analysis and interpretation, and linking concepts to real-life situations —components that are among the most important aspects of cognitive depth. Furthermore, repeated interaction with elements of the educational situation through this strategy provides learners with broader opportunities for research and reflection, leading to a deeper understanding of the concepts and topics presented.

Moreover, this strategy enables students to build their knowledge in an organized and interactive manner, through its five stages, which begin with attracting attention and asking questions, and progress to expansion and application. This sequence facilitates a transition from superficial thinking to higher levels of understanding and analysis, thereby enhancing students' ability to interpret information and apply it in new contexts.

Accordingly, it is clear that the use of the Pentagon strategy in teaching social studies contributes effectively to the development of cognitive depth skills, and is a successful educational alternative that can be relied upon in designing educational situations that target advanced thinking among female students, especially in the primary education stage. The current result is consistent with Zaki and Zangan (2023), who found that the application was in favor of the experimental group.

Based on the previous results, it was found that there was a clear improvement in the cognitive depth skills of students who underwent the new teaching method compared to students who learned using the traditional method. This improvement in performance was reflected in several cognitive skills.

In the skill of remembering, the results showed a significant superiority in students' retrieval of information and their recall of acquired knowledge. This is attributed to the fact that the teaching method used encouraged students to process information in-depth and link new concepts to prior knowledge. This aligns with Mayer's (2009) findings within the framework of the theory of meaningful learning, which suggests that in-depth processing of information contributes to better retention.

The study found that students improved their application skills by transferring knowledge to new situations and applying it in diverse educational contexts. This highlights the effectiveness of the educational method in promoting applied understanding, as it enhances the practical application of knowledge. This aligns with a study by Adel and Ibrahim (2021), which demonstrates superiority in the experimental group students.

Regarding the extended thinking skill, the results demonstrated students' ability to make connections between concepts, analyze information, and relate it to multiple domains. This is an indication that the adopted teaching method helped develop higher-order thinking, which goes beyond memorization and comprehension. The modified Bloom's theory also supports the idea that constructive interaction with content enhances analytical and synthetic thinking, leading to better outcomes in extended thinking.

Regarding strategic thinking skills, it was found that students who learned using the experiential method were able to plan their thinking, organize their responses more systematically, and make decisions based on logical analysis. This is attributed to the fact that the teaching method provided them with opportunities for reflective thinking and independent learning decision-making. Costa and Kallick (2008) indicate that learning environments that encourage reflection and self-reflection support the development of students' strategic thinking skills.

All of the above results are attributed to the fact that the teaching method used effectively motivated students to actively engage with the content, thereby enhancing the depth of their knowledge and their ability to effectively apply cognitive skills in various situations. This is supported by numerous researchers who have confirmed that active teaching methods have a positive impact on the development of higher-order thinking.

## 6. Conclusion

The study aimed to assess the effectiveness of a multimedia-based Pentagram strategy in teaching social studies to seventh-grade female students in Jordan. The results showed that the Pentagram strategy significantly improved cognitive depth skills among the students. The experimental group performed better on the cognitive depth test, with an apparent difference between the average performance of the experimental and control groups after the post-test. The teaching method explained (63.3%) of the variance in performance in combined cognitive depth skills.

The study analyzed cognitive depth skills in seventh-grade female students in social studies using the Pentagram strategy. The experimental group demonstrated better results in memory, application, extended thinking, and strategic thinking skills, while the control group had lower scores. The Pentagram strategy had the most significant impact on application skill, followed by memory skill, and strategic thinking skill. This suggests that the teaching method may be a useful tool for improving cognitive depth skills in individuals.

Educational models based on real or quasi-realistic situations promote reflection, analysis, hypothesis generation, and alternative solution-seeking processes, which are higher-level cognitive processes within Bloom's revised taxonomy. Cognitive support, integrated into these models through the use of open-ended questions, strategic guidance, and activities that require critical and creative thinking, also activates the brain's higher executive functions, positively impacting cognitive performance and depth of understanding.

The Pentagram strategy significantly improved cognitive depth skills in seventh-grade female students in social studies through open-ended questions, enhanced analysis, and linking concepts to real-life situations. The strategy allowed students to build knowledge in an organized and interactive manner through five stages, transitioning from superficial thinking to higher levels of understanding and analysis. The results suggest that developing cognitive depth skills is not an automatic process but a result of a systematic educational design that encourages active engagement with knowledge, reflection, application, and review.

The experimental method showed superior performance in memory, application, extended thinking, and strategic thinking skills compared to the traditional method. The method promoted

applied understanding, improved connections between concepts, and improved strategic thinking skills. Overall, the experimental method proved effective in developing cognitive skills.

In conclusion, the current study found that a multimedia-based Pentagon strategy significantly improved cognitive depth skills among seventh-grade female students in social studies. The experimental group performed better on cognitive depth tests, with the Pentagon strategy explaining 63.3% of the variance in performance. The strategy had the most significant impact on application skills, followed by memory skills and strategic thinking skills. The study suggests that developing cognitive depth skills is not an automatic process but a result of a systematic educational design that encourages active engagement with knowledge, reflection, application, and review. The experimental method was found to be effective in developing cognitive skills.

## 7. Recommendations

The study suggests employing the Pentagon strategy in education to develop higher-order thinking skills. It suggests incorporating activities based on analytical questions and complex tasks to enhance the interconnectedness between concepts and knowledge. It also recommends developing teacher training programs to apply the Pentagon strategy and using multimedia effectively. Future studies should compare the Pentagon strategy's effectiveness with other cognitive strategies and investigate the impact of multimedia on different learning styles and student groups at different educational levels.

## Declarations

**Author Contributions.** Lilian Alkhrfan: Literature review, conceptualization, review-editing, and writing, original manuscript preparation. Abeer al-refai : methodology, data analysis. All authors have read and approved the published version of the article.

**Conflicts of Interest.** The authors declare that they have no conflict of interest.

**Funding.** There is no funding.

**Ethical Approval.** Ethical Approval. The Ethics Committee of the Human Research Ethics Board (IRB) of the Deanship of Scientific Research and Graduate Studies, Yarmouk University, approved the ethical procedures of the research, taking into account the voluntariness, anonymity, and informed consent of the participants.

**Data Availability Statement.** The data used in this research is confidential and thus cannot be shared with third parties.

**Acknowledgments.** The authors acknowledge the contributions of several academics and professionals who reviewed and assessed Appendix 1, enhancing its academic integrity and polish. These include Professors Hani Obaidat, Ibrahim Al-Qaoud, Ali Kassab, Maher Mufleh Al-Zayyadat, Dr. Haifa Al-Dalabeh, Dr. Muhammad Jawarneh, Dr. Bassam Lababneh, Dr. Omar Al-Qudah, Mr. Hamed Talafha, Prof. Ibrahim Al-Qaoud (Retired), Prof. Mohannad Al-Da'jah, Dr. Emad Khallouf, and Dr. Nuha Al-Atoum. Their time, effort, and academic input are greatly appreciated.

## References

- Abdelmagied, A. A. (2025). Using the pentagram strategy in teaching science to develop scientific proficiency and visual thinking among Al-Azhar primary school students. *Journal of Faculty of Education–Assiut University*, 41(2), 1–41.
- Abdullahi, A., Amao, M. A., & Abubakar, U. (2024). Impact of audio-visual resources in improving teaching and learning in primary schools. *International Journal of Library Science and Educational Research*.

- Adel, R., & Ibrahim, M. (2021). The effect of the pentagram strategy achievement among fifth-year middle school students in chemistry. *Turkish Journal of Computer and Mathematics Education*, 12(11), 443–450. <https://doi.org/10.17762/turcomat.v12i11.5899>
- Al-Asadi, M., & Al-Fatlawi, K. (2023). The effect of the pentagram strategy on deep understanding among fifth-grade literary students in the Arabic language book. *Journal of Sustainable Studies, University of Babylon, College of Basic Education*, 5(3), 585–606. URL. <https://doi.org/10.22521/edupij.2025.16.266>
- Al-Gabry, A. B., Kamal Eldin, M. M., & Abdel Dayem, S. A. (2023). The role of pentagram strategy in enhancing an interactive content of branding design course. *International Design Journal*, 13(3), 393–400. <https://doi.org/10.21608/idj.2023.296280>
- Al-Hadidi, S. (2021). Pentagram theory-based program for developing socio-scientific reasoning and character for global citizen of science students teachers at the Faculty of Education, *Alexandria University*, 91(91), 3247–3331.
- Al-Kilani, A., & Al-Sharifain, N. (2016). Introduction to research in educational and social sciences: Its basics, methods, designs, and statistical methods (5th ed.). Amman, Jordan: Dar Al-Masirah for Printing and Publishing.
- Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York, NY: Longman. <http://eduq.info/xmlui/handle/11515/18824>
- Bilel, S. T., & Abboud, A. M. (2023). The effect of the pentagram and innovative matrix strategies on the acquisition of geomorphological concepts among students of the Geography Department. *Nasaq*, 39(3).
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). How people learn: Brain, mind, experience, and school. Washington, DC: National Academy Press. <https://bpb-us-e1.wpmucdn.com/sites.ucsc.edu/>
- Costa, A. L., & Kallick, B. (2000). Habits of mind: A developmental series. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).
- Costa, A. L., & Kallick, B. (2008). Learning and leading with habits of mind: 16 essential characteristics for success. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).
- Darling-Hammond, L., Barron, B., Pearson, P. D., Schoenfeld, A. H., Stage, E. K., Zimmerman, T. D., & Tilson, J. L. (2015). Powerful learning: What we know about teaching for understanding. Hoboken, NJ: John Wiley & Sons.
- Dolk, D., & Granat, J. (2012). Modeling for decision support in network-based services: The application of quantitative modeling to service. New York, NY: Springer Science & Business Media. <https://link.springer.com/>
- Facione, P. A. (2015). Critical thinking: What it is and why it counts. Millbrae, CA: Insight Assessment.
- Fullan, M. (2013). Great to excellent: Launching the next stage of Ontario's education agenda. Toronto, ON: Ontario Ministry of Education. <https://doi.org/10.12691/education-3-12B-9>
- Gahremani, M., Karami, S., & Balcaen, P. (2017). Pentagram of habits: Considering science teachers' conceptions of "habits of mind" associated with critical thinking in several of Iran's special gifted schools. *Gifted and Talented International*, 32(1), 3–26. <https://doi.org/10.1080/15332276.2017.1397901>

- Glick, M., & Pylyavskyy, P. (2016). Y-meshes and generalized pentagram maps. *Proceedings of the London Mathematical Society*, 112(4), 753–797. <https://doi.org/10.1112/plms/pdw007>
- Hattie, J. (2009). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. New York, NY: Routledge.
- Hattie, J. (2012). Visible learning for teachers: Maximizing impact on learning. New York, NY: Routledge. <https://doi.org/10.4324/9780203181522>
- Heinich, R., Molenda, M., Russell, J. D., & Smaldino, S. E. (2002). Instructional media and technologies for learning (7th ed.). Upper Saddle River, NJ: Prentice Hall. <https://www.scirp.org/>
- Hess, K. (2006). Applying Webb's depth-of-knowledge (DOK) levels in science. Retrieved November 10, 2006.
- Jackson, T. H. (2010). Teacher depth of knowledge as a predictor of student achievement in the middle grades (Unpublished doctoral dissertation). University of Southern Mississippi.
- Kalyani, L. K. (2024). The role of technology in education: Enhancing learning outcomes and 21st century skills. *International Journal of Scientific Research in Modern Science and Technology*, 3(4), 05–10. <https://doi.org/10.59828/ijrmst.v3i4.199>
- Kizlik, B. (2012). Measurement, assessment, and evaluation in education. Retrieved October, 10, 2015. <http://doi.org/10.12691/education-3-4-3>
- Marzano, R. J., & Kendall, J. S. (Eds.). (2006). The new taxonomy of educational objectives. Thousand Oaks, CA: Corwin Press. <https://www.ifeet.org>
- Mayer, R. E. (2009). Multimedia learning (2nd ed.). Cambridge, UK: Cambridge University Press. <https://doi.org/10.1017/CBO9780511811678>
- Mohsen, A. A. H. (2021). The effectiveness of a training program based on the Pentagon strategy to develop scientific research skills among female students at the College of Home Economics – University of Bisha. *International Journal on Humanities and Social Sciences*, 20, 237–256. DOI: <https://doi.org/10.33193/IJoHSS.20.2021.229>
- Nakamori, Y., & Wierzbicki, A. P. (2012). Knowledge pentagram system and applications. In D. Dolk & J. Granat (Eds.), *Modeling for decision support in network-based services: The application of quantitative modeling to service science* (pp. 257–278). Berlin, Germany: Springer. [https://doi.org/10.1007/978-3-642-27612-5\\_11](https://doi.org/10.1007/978-3-642-27612-5_11)
- Ovenhouse, N. (2019). Log-canonical Poisson structures and non-commutative integrable systems (Unpublished doctoral dissertation). Michigan State University.
- Putra, C. A. (2018). Utilization of multimedia technology for instructional media. *Journal of ICT in Education (JICTIE)*, 5(1), 1–8. <https://doi.org/10.37134/jictie.vol5.1.2018>
- Rickson, H. L. (2007). Concept-based curriculum and instruction for the thinking classroom. Thousand Oaks, CA: Corwin Press.
- Schwartz, R. (1992). The pentagram map. *Experimental Mathematics*, 1(1), 71–81.
- Shadish, W., Cook, T., & Campbell, D. (2002). Experimental and quasi-experimental designs for generalized causal inference. Boston, MA: Houghton Mifflin. <https://iaes.cgiar.org/sites/default/files/pdf/147.pdf>
- Tsuyoshi, K. (2016). Dynamical scale transform in tropical geometry. Singapore: World Scientific. <https://doi.org/10.1142/9395>

- UNESCO. (2002). Open and distance learning: Trends, policy and strategy considerations. Paris, France: United Nations Educational, Scientific and Cultural Organization. <https://www.scirp.org/>
- Viator, C. E. (2010). A critical analysis of the implementation of depth of knowledge and preliminary findings regarding its effectiveness in language arts achievement (Unpublished doctoral dissertation). University of Southern Mississippi.
- Zaki, R. M., & Zangan, S. D. A. (2023). The Effect of the Pentagon Strategy on the Achievement of Chemistry among the Second Grade Intermediate Female Students. *Journal of Namibian Studies*, 33. <https://doi.org/10.59670/jns.v33i.433>
- Zhao, Y. (2021). Learners without borders: New learning pathways for all students. Thousand Oaks, CA: Corwin Press. <https://doi.org/10.4135/9781506377407>
- Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, 41(2), 64–70. [https://doi.org/10.1207/s15430421tip4102\\_2](https://doi.org/10.1207/s15430421tip4102_2).
- Zohar, A., & Dori, Y. J. (2003). Higher order thinking skills and low-achieving students: Are they mutually exclusive? *The Journal of the Learning Sciences*, 12(2), 145–181. [https://doi.org/10.1207/S15327809JLS1202\\_1](https://doi.org/10.1207/S15327809JLS1202_1).

### About the Contributor(s)

**Lilian Mohammad Alkhrfan**, is a PhD student in the Department of Curriculum and Instruction, Social Studies, Yarmouk University.

Email: [lylyanalkhrfan83@gmail.com](mailto:lylyanalkhrfan83@gmail.com)

ORCID: <https://orcid.org/0009-0002-7254-5280>

**Professor Abeer Mohammad Alrefai**, specialized in social studies curricula and instruction. Yarmouk university. Jordan.

Email: [abeer.alrfai@yu.edu.jo](mailto:abeer.alrfai@yu.edu.jo)

ORCID: <https://orcid.org/0000-0003-3479-9626>

---

**Publisher's Note:** The opinions, statements, and data presented in all publications are solely those of the individual author(s) and contributors and do not reflect the views of Universitepark, EDUPIJ, and/or the editor(s). Universitepark, the Journal, and/or the editor(s) accept no responsibility for any harm or damage to persons or property arising from the use of ideas, methods, instructions, or products mentioned in the content.

---

### Appendix I.

#### Cognitive Depth Test