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The Efficacy of Using Augmented Reality Technology to Develop Multiple Intelligences for Children in Early Childhood

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Abstract: The current study aims to measures the effectiveness of using augmented reality technology to develop multiple intelligences in children in early childhood. The semi-experimental method was used with one group (pre and post). The research was applied to (30 children) from kindergarten children. Their ages ranged between (5-6) years. The study used the following materials and tools: a program based on the use of augmented reality technology to develop multiple intelligences in children in early childhood, a measure of multiple intelligences (linguistic - social - logical-mathematical - personal - natural intelligence) among children in early childhood (prepared by the researchers), and the study reached the following results: the effectiveness of using augmented reality in the development of multiple intelligences in children in early childhood, where the experimental group in the pre-application obtained an average of (13.97), while in the post-application it got an average of (25.80). The pre-application had a general average of (2.87), while it got an average of (5.13) in the post-application. The post-test has an average of (5.27), the effectiveness of using augmented reality technology in developing social intelligence Where the experimental group in the pre-application obtained a general average of (2.73), while in the post-application it got an average of (5.20). The post application has an average of (5.07) the effectiveness of using augmented reality technology in developing natural intelligence, where the experimental group in the pre application got an average of (2.73), while in the post application it got an average of (5.13), in the light of the results of the study, the researchers presented several Recommendations for the development of multiple intelligences in children in early childhood, which are: directing those in charge of preparing kindergarten curricula to include augmented reality technology in kindergarten curricula, directing the interest of kindergarten teachers, using augmented reality technology in developing multiple intelligences in children in early childhood, directing kindergarten teachers the diversity of methods and strategies used to develop multiple intelligences in children in early childhood.

Keywords: Augmented reality technology, Multiple intelligences, Early childhood.

1 Introduction

Caring for the kindergarten stage is one of the things most inferred by the development of community awareness and the advancement of society, as caring for childhood is part of caring for the present and the future together, as children constitute the most dangerous and important segment in any society. The progress of any society depends on the extent of its interest in early childhood.

The early childhood stage is one of the most influential stages of human development in shaping the child's personality and determining the parameters of what he will be like in the future. As the first years of a child's life, including pleasant or painful experiences, contribute greatly to drawing the lines of his future life, and studies have indicated the importance of this stage, and for this reason the attention of researchers and those interested in aspects of human development has turned to it [1].

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Studying the growth of the child's capabilities and the development of his intelligence is one of the areas that received wide attention in the field of psychology, and until recently, mental abilities constituted an obscure focus of philosophical discussion. The studies did not take the form of a scientific nature, which depends on the experimental approach, and thanks to the continuous efforts of psychologists to identify these abilities, the studies have gone beyond the stage of description, to the stage of accurate scientific identification.

In 1983, the American scientist Howard Gardner presented his book in which he challenged the traditional theory that there is one intelligence for each of us, through his book “Frames of Mind”, in which he revealed that each of us has different types of intelligences. Gardner translated his ideas into a theory he called the Multiple Intelligence Theory, in which he indicated that intelligence represents a specific intellectual ability that requires a set of problem-solving skills, which enables the individual to solve problems or difficulties that stand in his way and enables him to create an effective solution when he is suitable for acquiring new knowledge [2].

Gardner's theory of multiple intelligences is one of the useful theories in knowing learning styles and teaching methods, as it discovers the strengths and weaknesses of the learner. Since each person is distinct from others, intelligence differs from one person to another, which highlights the true meaning of individual differences between people and the unique characteristic that distinguishes one person from another [3].

Among the theories of intelligence that concerned the field of education and individual differences is the theory of multiple intelligences. Gardner’ book (frameworks of mind) suggested that there are at least seven basic intelligences for every individual expanding the field of human capabilities, beyond the estimation of the level of intelligence, and this theory is considered as the official statement to object that there is only one type of intelligence that determines the extent of success in human life. As well as the response to the theory of the rate (quotient) of intelligence, which is based on the principle that “human perception is monolithic, and that individuals can be described as possessing individual intelligence that can be quantified.” In contrast to this reduction, this theory looks at intelligence as “the ability to solve problems and the formation of outgrowths in a fertile and natural temporal context.”

The theory of multiple intelligences can be applied in the classroom through multiple-spatial activities. For instance, in linguistic intelligence, students read, write, and get information. In logical intelligence, students engage with mathematics games and science experiments, infer, and solve problems. In spatial intelligence, students use various art media and disassembling and assembling games. In bodily intelligence, students develop models and play dramatic roles. In musical intelligence, students compose and sing songs and chants about the theme of the lesson. In intrapersonal intelligence, students explore the theme of the lesson through study, reflection, and individual projects. In interpersonal intelligence, students develop collaborative learning skills through problem-solving, answering questions, engaging in educational games, thinking sessions, and group discussions. In naturalist intelligence, students explore the theme of the lesson by reading about nature [4].

Multiple intelligences are one of the high-end forms of human activity. They have become a major scientific issue in some countries because scientific development cannot be achieved without developing these human abilities (skills). Moreover, human development depends on the available capabilities to confront urgent and exacerbating problems. Conflicts in advanced countries are brain-based to achieve scientific and technological development to ensure leadership. Besides its scientific and educational importance, developing the skills and forms of intelligence relates to developing and confronting future challenges in a world led by intelligence. Additionally, education should aim at teaching children how to think and learn. A kindergarten child has massive kinetic and creative capabilities and powers, which

urges the need to discover, train, and develop these capabilities as a lifestyle in the future. The interest in the child, the discovery of capabilities, and sound guidance are essential because tackling multiple intelligences means tackling the future in one way or another and addressing the changes in the human future and jobs, community and its systems, and people's relations. Modern studies stress that education or curricula based on sound and planned rules give better results. The early detection of multiple intelligences plays a key role in determining the care and development methods to be delivered to children because the human brain is at the peak of flexibility and adaptability in early childhood, especially before the age of ten years, ensuring that the early detection of multiple intelligences gives better opportunities for development and effectiveness. Therefore, early detection of multiple intelligences of children is highly recommended because defining intelligences based on their indicators is not easy [5].

Accordingly, there are new dimensions involved in this concept, which lie in the ability to solve problems to which the individual is exposed, and to generate new problems, in order to solve them, in addition to the ability to produce what is new and values in the life and culture of the individual [6]. This was confirmed by the study of Hussain, which aimed at developing children's multiple intelligences through enrichment activities in Bismar, on the existence of differences between children's scores in the telemetry of the seven intelligences for each of the experimental and control groups in favor of the experimental group. The existence of differences between the scores of the children of the experimental group in the pre- and post-measurement of the seven intelligences in favor of the post-measurement is due to the enrichment activities provided for the development of the multiple intelligences of the children [7].

Ozi also stressed the importance of developing the intelligence of learners, investing their potential and activating educational work and making them keep pace with the scientific development achieved by the cognitive psychology within which this attempt moves [8].

Multiple types of intelligences

Gardner divided the idea of traditional intelligence into seven distinct categories, then added two intelligences to become nine intelligences, and the following is a presentation of some of these intelligences as mentioned by most scholars [7, 9-12].

Linguistic intelligence:

It is one of the components of Gardner's theory, and he believes that it is possible to identify this intelligence in an individual through clear indicators, including the ability to memorize quickly, love of speaking, passion for reading, and linguistic games [10]. Linguistic intelligence is the ability to generate language and linguistic structures that include poetry, writing stories, using metaphors, passion for words, passion for language acquisition, the ability to employ language for different goals, and the use of language for expression, communication, persuasion, and presentation of information and ideas. And not only language production, but a high sensitivity to slight differences between words and the order and rhyme of word [13]. It also means the ability to use the mother tongue and perhaps other languages efficiently in oral expression (such as storytelling, rhetoric), and written expression such as poetry, composition, fiction, drama, and various types of writing in order to express what is going on in the mind and understand others.

This type of intelligence includes the ability to process the structure of language, its sounds, meanings, and the scientific uses of language, including statement, persuasion, remembering information, clarifying it, explaining, and using language for itself to speak for itself [14].

Linguistic intelligence refers to the ability to use words effectively, whether orally (storytelling, rhetoric) or through writing (poetry, language construction, and journalism). This type of intelligence includes

the ability to synthesize and build language, and to recognize the phonetics of language and the scientific dimension of language uses. Linguistic intelligence appears in the ability to persuade others to act in a certain way and to explain and convey information. The linguistically intelligent person has a distinct ability to memorize, even when it comes to mathematical issues [3]. Hariri also sees it as the ability to use language effectively, such as the ability to process words for multiple purposes. Such as fluency in speech and expression, the ability to perceive discussions and convince others of points of view, writing poetry, telling a story, excellence in rhetoric speech, the ability to use rhetorical expressions such as metaphor and simile, writing, representation based on verbal expression, feeling the difference between words, their order and rhythm. The superior learner in this type of intelligence is characterized by his love of reading, writing, storytelling, verbal and written expression, and the ability to remember names, dates, and events. The linguistically intelligent person is the one who has outstanding performance in language-related subjects and skills such as speaking, reading, writing, group discussions, stories, and linguistic games [15].

To judge a child for having the abilities of linguistic intelligence, the following appearances must appear on him:

- Likes to listen to others talking, and gets annoyed when people use the wrong language.
- Others understand him when he talks, he likes to tell stories.
- Likes to learn a new word, and has a good memory for names, dates, and other things [9].

Logical Mathematical Intelligence:

It is the ability to deal with numbers and solve complex arithmetic and engineering issues by setting hypotheses and establishing abstract relationships by inference using symbols, and this type is developed among scientists, physicists, and those interested in mathematics [16]. Suleiman explains that this intelligence is clearly found among mathematicians, computer programmers, merchants, accountants, and engineers [17]. Phipps ensures that high achievers in mathematics, engineers, and children with this intelligence tend to the classification, synthesis, structure, model completion, and competence in mathematical activities [18].

The abilities of logical mathematical intelligence can be summarized in the following:

- The ability to use numbers efficiently, such as mathematicians, accountants and statisticians.

- Sensitivity to logical models and relationships in the declarative and hypothetical construction, i.e. regarding cause and effect, and other models of abstract thinking.

- The ability to tackle logical problems with extraordinary speed mentally, such as philosophers and lawyers.

- Observation skills and inferential abilities, and these skills and abilities have an important role in this intelligence.

Gardner believes that logical mathematical intelligence is closer to logical thinking than linguistic intelligence.

The researcher reaches a solution to the problem before formulating it linguistically, and Gardner mentions that this intelligence has certain locations in the brain, and its evidence is neurological research.

In order for a child to be judged to have the capabilities of mathematical intelligence, the following appearances must appear on him:

- He enjoys mathematics, adding numbers to each other easily in his mind.
- He loves practical experiments and asks a lot about how things work.
- He enjoys playing chess and computer games based on strategy. He enjoys puzzles [7].

Social Intelligence:

It describes the individual's ability to understand and interact with others effectively. A leader can have this type of intelligence demonstrated by social skills and the ability to consider others' needs. A child with this intelligence has many friends, interacts socially with others, has leadership qualities, and plays in groups [18]. It is the ability to understand others, their intentions, motives, and feelings, and distinguish between them, and includes sensitivity to facial expressions, voice, and gestures, and the ability to distinguish between different types of interpersonal cues, and the ability to sub-response to those cues [12].The owners of these talents have certain skills, such as high skills in coexistence with others, and they appear to have features of natural leadership, the ability to give advice and solve problems, love of belonging, love of playing games with others, and they have a sense of empathy towards others [17].

Intrapersonal intelligence:

It describes the personal excellence of understanding deficiencies and estimating feelings, fears, and motifs. A person can use this information to organize their life and set certain clear objectives and steps. A child with this intelligence tends toward isolation and enjoys playing and working alone. Moreover, one's production is original, and the child is speculative and a thinker [18]. Defined as the individual's ability to correctly perceive himself, to be aware of his feelings, values, beliefs, thinking, and motives, to identify his strengths and weaknesses, and to act in a manner consistent with this understanding, which helps him to adjust and balance his behavior, and to learn through observation and enjoyment [11]. Interpersonal intelligence or intrapersonal intelligence of the relationship with oneself includes the ability to understand one's inner feelings and sensations, the ability to know oneself and the ability to act in accordance with this knowledge. This intelligence also includes the formation of a person's self-image in terms of aspects of strength and weakness, awareness of motor moods, and the individual's ability to self-control, self-understanding, and self-esteem.

This intelligence includes:

- The ability to focus, internal thinking.
- Awareness of different internal feelings.
- The ability to think and reason at higher levels and to understand one's relationships with others.

In order for a child to be judged to have a measure of intrapersonal intelligence, the following appearances must appear on him:

- Loves to lead, needs a quiet place to work alone, loves independence.
- Likes and is able to do things of particular importance to him.
- Has insight into his strengths and weaknesses and can articulate them easily.
- Gives advice to other children with problems.
- Has sensitivity, concern, and empathy for others. [9,11].

Natural intelligence

It starts early in childhood, as demonstrated by the child's tendency to play with animals and enjoy watching them directly or via mass media. Children with this intelligence love animals, tend to watch and care for them, classify organisms, including animals and plants, read books on nature, and spend time outdoors [18]. This intelligence is the ability to distinguish and classify things that exist in the natural environment such as plants, animals, birds, fish, insects and rocks, using this ability to increase production and to Identify similarities and differences between them. This intelligence depends on observing these patterns in nature, and therefore this type of intelligence appears among farmers and scientists of each of nature, plants, animals, and insects [10]. In order to judge whether a child has a level of normal intelligence, the following appearances must appear on him:

- He enjoys visiting parks and zoos, nature museums, water museums, botanical museums, camping and going out in nature.

- He enjoys gardening, pets, and environmental issues.

- He likes to collect environmental components such as butterflies, flowers, tree leaves, stones, and shells.

- He likes to read books and magazines and watch TV programs about nature. [11].

Recent years have witnessed an actual launch of augmented reality technology, as it has departed from the theoretical framework in universities and was written about in various foreign blogs and websites to describe this technology, which has received increasing attention during the past few years as a result of its widespread use, and the applications of this technology are not limited to a specific field; Rather, there are many areas in which the application of this technology will become very useful, in addition to that, technology is constantly evolving as a result of its entry into multiple fields.

Augmented reality is one of the most interesting modern technologies in the field of education, as it is a powerful and stimulating tool that can engage many of the learner's senses through the correct combination of sound, image and touch, and based on that, all those involved in educating the child must face the challenges of society and to keep pace with the development taking place in various aspects of life. To achieve this, we have to motivate the learners, as learning becomes more effective when the learner accepts and engages in learning. Children tend to learn visually using images and visuals, highlighting the opportunities augmented reality provides to language [19].

The importance of augmented reality in education:

The concept of reinforcement learning is defined as a learning technology for the learner, where the learning environments adopt their methods based on the needs and requirements of the learners. It is not necessary for the term environment in this context to be limited to physical learning environments such as classrooms; Rather, it may refer to digital learning environments where learners can stimulate their ability to discover, and this will ultimately contribute to the acquisition of greater knowledge. The techniques used in reinforcement learning are usually closely related to touch screens and voice recognition technologies, and this can make learning contexts compatible with the learner's needs by displaying clear texts and images in addition to video or audio clips. For example, using reinforcement learning technology, it is possible to show the footnotes of speech either through the display screen or through the DUH headphones, in the form of voice instructions. Therefore, it is not surprising that reinforcement learning has proven its ability to develop learning performance due to its prominent role in raising the efficiency of education. The role of augmented reality in education can be clarified, as he referred to Attar and Kansara [20].

Thus, the importance of augmented reality in education can be summarized as follows:

- Stimulating children's motivation and enthusiasm; educational material is offered in a fun and attractive manner compatible with the generation of technology to engage learners in ways that are otherwise inaccessible by activating senses.

- Providing educational experiences through three dimensional models to enable the learner to watch and analyze the topics from different aspects

- Providing educational experiences in the same educational site that are hard to access, such as space and volcano

- Allowing children's engagement in authentic practices that may be hard to attain in reality

- Augmented reality does not require a certain educational environment, as it can be applied in the classroom.

- Considering individual differences; augmented reality allows watching shapes from different aspects, and the learner interacts with authentic experiences and avoids misconceptions.

- Promoting cooperative learning and social interaction between children in the same educational environment by improving computerized programs via smart phones and active participation in solving educational problems

- Providing opportunities for more realistic learning and independent teaching styles

- It makes learning fun and challenges the learner's abilities to be creative.

- Compensating for the lack of resources in education, low cost, and creating an exciting educational environment.

Justifications for using augmented reality:

1- One justification is the use of augmented reality on learners compared to learning experiences without the use of augmented reality.

2- An increase in understanding the scientific content in certain topics, and the augmented reality has a more effective impact on teaching students compared to the impact of other means: such as books, video tapes, desktop computers.

3- Keeping information in memory for a longer period.

4- High enthusiasm among students when applying augmented reality in education.

5- Improved cooperation relations between group members and between students and their teachers.

6- Participation and motivating students to discover informative educational material from different angles.

7- Augmented reality helps in teaching school subjects that students cannot easily touch or interact with except through direct real experience.

8- Encouraging the student's creativity and expanding his imagination to understand facts and concepts.

9- Help students control the way of learning through education according to the extent of their absorption and their preferred method.

10- There is a reliable learning environment suitable for multiple learning styles and different ages.

From the foregoing, we find that there are many other justifications, including the commitment to keeping pace with our schools for development, as the traditional methods used in our schools do not keep pace with the times, do not encourage them, are traditional, and do not help in the delivery of knowledge, as most of the courses may develop. Therefore, we absolutely need to develop the means commensurate with the era in which we live, especially these technologies that help in raising the productivity of the teacher and the learner [20].

Augmented reality features:

Among the characteristics of augmented reality: Simple and effective, it provides the learner with clear and concise information, enables the teacher to acquire his information and data, and to communicate them in an easy way, allowing smooth interaction between both the teacher and the learner. It makes the procedures between the teacher and the learner transparent and clear, and it is characterized by its effectiveness in terms of cost, and its ability to expand easily. The technology of virtual reality and augmented reality, which falls under e-learning, is one of the most prominent means in our modern era that has contributed to supporting the educational process and encouraged children's mental and physical creativity. It actively contributed to facilitating and easing the design of an educational augmented reality environment that is attractive, rich, fun, and accessible to everyone, whether they are children or teachers, through multiple electronic platforms such as personal computers or smart phones. Schools and universities in many countries, east and west, relied on it, and the numbers of its users are still increasing at a tremendous speed. To visualize this technology practically, the idea of this research was to use this technology in the development of multiple intelligences.

Problem of the Study:

The early childhood stage is considered one of the most important stages in the formation of young people, in which many multiple intelligences (linguistic - social - logical-mathematical - personal - natural intelligence ...) grow in children. The multiple intelligences are among the very important aspects that the child needs to develop, and which begin to be formed in children at this stage. Through some field visits and supervision of practical training students in kindergartens and early childhood schools, it was found that kindergarten teachers use traditional methods and methods to develop the multiple intelligences of children. Both studies; Al-Arabi, (which aimed at identifying the effectiveness of a program based on the strategy of playing and learning to develop multiple intelligences among kindergarten children, with the need to spread the culture of multiple intelligences among teachers and parents and work to update the activities provided to kindergarten children and develop them permanently and continuously in line with the nature of multiple intelligences) [21], and Asad, (which aimed at investigating the impact of the teaching method based on educational games on the development of multiple intelligences among kindergarten students in Kuwait), recommended providing the appropriate environment for activities based on educational games at all educational levels, and holding training courses for kindergarten teachers and teachers at different educational levels on employing educational games in the teaching process, and urging kindergarten teachers to design meaningful educational games with an effective objective [22].

The study of Al-Abdulkarim and Al-Helou confirmed that the intelligences are closely related to the society surrounding the child, the processes of socialization, and the methods of parental treatment that the child receives. The family, peers, and educational institutions have a major role in promoting, developing and growing some types of intelligence, and disrupting and discouraging the growth of other types [23]. The study of Abdel-Hamid aimed at: Determining the effectiveness of multiple intelligences activities in developing visual-spatial thinking skills and logical-mathematical thinking, on the existence of differences in favor of the experimental group due to the use of multiple intelligences activities.

Augmented reality technology also has a significant impact on the development of multiple aspects in children, including multiple intelligences [24].

Many studies have also confirmed the importance of using augmented reality technology for children, the study of Al-Yousefi, which aimed to measure the effectiveness of using augmented reality applications as a tool for teaching and learning when teaching kindergarten children the English alphabet, and used the experimental approach with two experimental and control groups, and the experimental group was studied through augmented reality applications, while the control group was taught in the traditional way. The study showed that there was a very strong linear relationship between the interaction of children in the experimental group with the content of the alphabet lessons presented through augmented reality and their scores on the English alphabet test. Therefore, the researcher considered taking advantage of the many characteristics and advantages available in augmented reality technology to develop multiple intelligences in children so that they can employ them in their academic and life situations [25]. The problem of the current research can be formulated by answering the main question: *What is the effectiveness of using augmented reality technology to develop the multiple intelligences of children in early childhood?*

The following questions arose from it:

- What is the effectiveness of using augmented reality technology to develop linguistic intelligence in children in early childhood?

- What is the effectiveness of using augmented reality technology to develop logical and mathematical intelligence in children in early childhood?

- What is the effectiveness of using augmented reality technology to develop social intelligence among children in early childhood?

- What is the effectiveness of using augmented reality technology to develop intrapersonal intelligence in children in early childhood?

- What is the effectiveness of using augmented reality technology to develop children's natural intelligence in early childhood?

Research Aims:

The research seeks to achieve the following main objectives:

- Measuring the effectiveness of using augmented reality technology to develop multiple intelligences in children in the early childhood stage.

The following sub-objectives branch out from it:

- The effectiveness of using augmented reality technology to develop linguistic intelligence in children in early childhood.

- The effectiveness of using augmented reality technology to develop logical and mathematical intelligence in children in early childhood.

- The effectiveness of using augmented reality technology to develop social intelligence among children in early childhood.

- The effectiveness of using augmented reality technology to develop intrapersonal intelligence in children in early childhood.

- The effectiveness of using augmented reality technology to develop children's natural intelligence in early childhood.

Research Importance:

The research derives its significance from the importance of multiple intelligences and its modern concept, and the technology of augmented reality is one of the modern technologies that bring concepts closer to children in early childhood.

- It will also be useful in directing the interest of those in charge of preparing the curricula in the early childhood stage in including augmented reality technology in the early childhood curricula for children.

- It can contribute to directing education departments by directing teachers to use this technology and link it to the curricula in the early childhood stage.

Research Limits:

Objective limits: The research deals with some of the multiple intelligences of children such as (linguistic - social - mathematical logical - personal - natural intelligence ...) and ways to develop them. It will also deal with augmented reality technology and its application to the research sample.

Temporal limits: It was applied to the research sample in the first semester of the year 1443 AH.

Spatial limits: The research was applied to children in early childhood (5-6) in one of the governmental kindergartens of the Education Department in Najran.

Research Terminology:

Multiple Intelligences: Nofal defines multiple intelligences as a functional concept that influences people's life in different ways. Gardner introduces the concept of as a means of drawing the broad map of human potentials in eight intelligences: linguistic, logical- mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist [9].

Gardner has defined multiple intelligences as the ability to solve problems or create valuable products within a cultural situation or situations [10].

Gardner's view of intelligence was that it is nothing but neural potentials that can be activated. Gardner considered intelligences as separate intelligences, each of which can be developed separately, and one intelligence may be affected by the other [26].

Jaber also believes that multiple intelligences are the mental skills that can be developed, which agreeing with Gardner, represented in linguistic intelligence, logical intelligence, mathematical intelligence, spatial intelligence, bodily motor intelligence, musical intelligence, social intelligence, interintrapersonal intelligence and natural intelligence [12].

It is defined procedurally as mental skills that can be developed through the use of augmented reality technology and includes (linguistic - social - mathematical logical - personal - and natural intelligence).

Augmented Reality:

Defined as a system that integrates virtual reality environments with real environments through special techniques and methods; Examples of this: the landing strips can be lit in front of planes in real airports, or the surgeon can see virtual information during the actual surgery that shows him the places that must be actually removed [27].

It is also defined as adding, assembling, and imaging digital data using real-world digital displays of the environment surrounding the organism, and from a technological perspective, augmented reality is often associated with wearable computers, or smart devices that can be carried [28]. Dunleavy and Dede define it as a term that describes technology that allows simultaneous virtual mixing of digital content from

computer software and media with the real world [29]. There are several definitions of "augmented reality." Because it is relatively new, it has several Arabic synonyms, such as "added reality, improved reality, and augmented reality." It is called this way in Arabic because of its Arabic translation as "augmented reality" (AR). It is a field of virtual reality (VR) and represents the integration between the virtual and real realities to help a person feel one or all feelings in a virtual environment integrated into the real world [30]. It is defined procedurally as an interactive technology that relies on showing reality in the form of technical content and is used to develop some multiple intelligences (linguistic - social - logical-mathematical - personal - natural intelligence).

Early Childhood:

It is defined procedurally as the stage in which children join kindergarten from the age of 5-6 years.

2 Methodologies

The semi-experimental approach is defined as: the method by which the researcher can know the effect of the cause (the independent variable) on the result of the dependent variable [31]. The study used the semi-experimental approach with one experimental group to measure the effectiveness of using augmented reality technology to develop multiple intelligences (linguistic - social - logical-mathematical - personal - natural intelligence ....) in children during early childhood.

Sample: The study was applied to children in early childhood (5-6) in one of the government kindergartens affiliated to the Education Department in Najran.

Study population: The study population consisted of (200) children enrolled in government kindergartens affiliated to the Department of Education in Najran aged (5-6) years.

The study sample: The sample of the exploratory study consisted of 30 children and the main sample consisted of 30 children aged (5-6) enrolled in government kindergartens in Najran.

Study tools and materials:

Study tools:

First: the test of multiple intelligences (linguistic - social - logical-mathematical - personal - natural intelligence) for children in early childhood (prepared by the two researchers) who were applied to them before and after using augmented reality technology to measure the aim of the study of identifying the effectiveness of augmented reality in developing multiple intelligences among children of early childhood. The test was developed according to the following steps:

- Determining the test objectives: The test was developed to identify the effectiveness of augmented reality in developing multiple intelligences among children of early childhood.
- Resources for building the test: The researcher adopted these resources to build the test:
- Research and studies on the stage and philosophy of early childhood, characteristics of child development, and multiple intelligences and augmented reality in this stage
- Research and studies on building and designing illustrated books for children in early childhood.

Preparing test questions:

The illustrated test comprises five minor domains (linguistic- social- logical mathematical- intrapersonal- naturalist), each with 6 multiple choice items to be a total of (30) items. A child is asked a question and offered the illustrated alternatives. One circles the correct choice from one’s perspective. Because multiple choice questions depend on pictures, they are taken into account to be clear, unique, and appropriate in terms of size, form, and color.

Marking method:

• To have equal weights of the illustrated test, a child circles (A-B-C-D) the correct answer. The test consists of (30) items, each with one mark. Thus, the total marks are 30.

Forming the test instructions: The instructions are one of the most important aspects of building the scale. They aim to explain the idea of the test in the simplest form, answer method, procedures, handling the questions, observing the behavior, and marking, and instructing on the way of answering the questions. They include two main sections: Instructions to the teacher and instructions to the children subject to the test. They are inserted on the first page and include:

- A concise explanation of the test objective
- Illustrating the number of questions.
- Illustrating that the answer is inserted in the test paper by circling the correct answer.
- The researcher's question and presentation of the image to the student
- Giving examples to the child to illustrate how to answer.
- Instructing the students that they should not answer until being allowed and understanding the test instructions well.
- Answering all questions
- Showing that the answer is based on the student's opinion only.

Ensuring the Validity of the Draft of the Test

The researchers ensured the validity of the draft of the test by calculating the psychometric characteristics of the test and its items by

Calculating the validity and reliability of the study tool (test of multiple intelligences)

Face (reviewer) validity:

The researchers ensured the face validity of the test of multiple intelligences among kindergarten children by presenting it to a group of (11) specialized and experienced reviewers to review the test after reviewing the title, questions, and objectives of the study. The reviewers were asked to give opinions and notes on the appropriateness of the items to the study topic and the multiple intelligences to be measured in terms of the activity's appropriateness to the child's age, appropriateness of the pictures to the activity, and accurate language phrasing. Some items were modified in the light of the reviewers' opinions.

The validity and reliability of the research tool (the multiple intelligences scale).

Apparent honesty (truthfulness of arbitrators):

The scale was presented in its initial form to a group of specialized professors in order to express an opinion on the following elements: The suitability of the phrase for the dimension to which it belongs, the suitability of the linguistic formulation of the phrases, the existence of an amendment by deletion or addition to some of the scale phrases, and it was agreed on all the scale items, and no one was deleted from it.

Results of the validity of the internal consistency of the scale:

To verify the validity of the internal consistency, the two researchers calculated the correlation coefficients between the scores of each question of the test and the total scores of the dimension to which the question belongs. The results were as shown in Table (1):

Table 1: the correlation coefficients between the scores of each question of the test and the total scores for the dimension to which the question belongs.

Dimensions	question number	correlation coefficient	significance level	Statistical significance
Linguistic intelligence	1	0.65	0.01	function
	2	0.88	0.01	function
	3	0.84	0.01	function
	4	0.84	0.01	function
	5	0.70	0.01	function
	6	0.78	0.01	function
Logical mathematical intelligence	7	0.82	0.01	function
	8	0.63	0.01	function
	9	0.69	0.01	function
	10	0.68	0.01	function
	11	0.57	0.01	function
	12	0.77	0.01	function
Social Intelligence	13	0.56	0.01	function
	14	0.59	0.01	function
	15	0.72	0.01	function
	16	0.77	0.01	function
	17	0.82	0.01	function
	18	0.74	0.01	function
Intrapersonal intelligence	19	0.59	0.01	function
	20	0.63	0.01	function
	21	0.73	0.01	function
	22	0.63	0.01	function
	23	0.55	0.01	function
	24	0.57	0.01	function
Natural intelligence	25	0.71	0.01	function
	26	0.76	0.01	function
	27	0.71	0.01	function

	28	0.76	0.01	function
	29	0.65	0.01	function
	30	0.78	0.01	function

Table (1) shows the correlation coefficients between the scores of each question of the test and the total scores for the dimension to which the question belongs, as they ranged between (0.55 - 0.88), and all of them are statistically significant. Thus, the questions are considered valid for what they were designed to measure.

- ❖ The results of the constructive validity of the test and its dimensions

To verify the constructive validity of the test, the two researchers calculated the correlation coefficients between the total scores for each dimension and the total scores for the test. The results were as shown in Table (2):

Table 2: Shows the correlation coefficients between the total scores for each of the dimensions and the total scores of the test.

Scale dimensions	correlation coefficient	significance level	Statistical significance
Linguistic intelligence	0.88	0.01	function
Logical mathematical intelligence	0.85	0.01	function
Social Intelligence	0.90	0.01	function
Intrapersonal intelligence	0.91	0.01	function
Natural intelligence	0.82	0.01	function

Table (2) shows the correlation coefficients between the total scores for each dimension and the total scores for the test, as the dimensions ranged between (0.82 - 0.91), all of which are statistically significant, which indicates the validity and homogeneity of the scale dimensions.

- ❖ Results of the stability of the test

The two researchers verified the stability of the scale through Cronbach's alpha coefficient method, and the results came as shown in Table (3).

Table 3: shows Cronbach's alpha coefficients for the test and its dimensions.

Scale dimensions	No of phrases	Cronbach's alpha coefficient
Linguistic intelligence	6	0.87
Logical mathematical intelligence	6	0.79
Social Intelligence	6	0.79
Intrapersonal intelligence	6	0.68
Natural intelligence	6	0.82

Total scale	30	0.94

Table (3) shows the stability coefficients for the test and its dimensions, which ranged between (0.68 - 0.87) for the dimensions, and the stability coefficient for the scale as a whole was (0.94), which is a high stability ratio, which reassures the researcher of the results of applying the scale.

- ❖ Discriminatory ability of the test phrases.

Table 4: shows the results of the comparison between the group of children with high scores and the group of children with low scores in the multiple intelligences test.

question number	High scores (n = 9)		low scores (n = 9)		Mann-Whitney test	
	mean of squares	sum of squares	mean of squares	sum of squares	Z	significance level
1	14.00	126.00	5.00	45.00	4.12	0.001
2	14.00	126.00	5.00	45.00	4.12	0.001
3	14.00	126.00	5.00	45.00	4.12	0.001
4	14.00	126.00	5.00	45.00	4.12	0.001
5	14.00	126.00	5.00	45.00	4.12	0.001
6	14.00	126.00	5.00	45.00	4.12	0.001
7	14.00	126.00	5.00	45.00	4.12	0.001
8	14.00	126.00	5.00	45.00	4.12	0.001
9	13.00	117.00	6.00	54.00	3.29	0.001
10	14.00	126.00	5.00	45.00	4.12	0.001
11	14.00	126.00	5.00	45.00	4.12	0.001
12	14.00	126.00	5.00	45.00	4.12	0.001
13	14.00	126.00	5.00	45.00	4.12	0.001
14	14.00	126.00	5.00	45.00	4.12	0.001
15	14.00	126.00	5.00	45.00	4.12	0.001
16	14.00	126.00	5.00	45.00	4.12	0.001
17	14.00	126.00	5.00	45.00	4.12	0.001
18	14.00	126.00	5.00	45.00	4.12	0.001
19	14.00	126.00	5.00	45.00	4.12	0.001
20	14.00	126.00	5.00	45.00	4.12	0.001
21	14.00	126.00	5.00	45.00	4.12	0.001
22	14.00	126.00	5.00	45.00	4.12	0.001
23	13.50	121.50	5.50	49.50	3.69	0.001
24	14.00	126.00	5.00	45.00	4.12	0.001

25	13.00	117.00	6.00	54.00	3.29	0.001
26	14.00	126.00	5.00	45.00	4.12	0.001
27	14.00	126.00	5.00	45.00	4.12	0.001
28	14.00	126.00	5.00	45.00	4.12	0.001
29	14.00	126.00	5.00	45.00	4.12	0.001
30	14.00	126.00	5.00	45.00	4.12	0.001

Table (4) shows the results of the "Mann-Whitney" test for the comparison between the mean scores of the group of high-scoring children and the group of low-scoring children in the Multiple Intelligences test, where the values of (Z) ranged between (3.29 - 4.12), all of which are statistically significant. This indicates that there are statistically significant differences between those with high scores and low scores in all the test expressions, and this indicates the discriminatory ability of the test expressions.

Study materials

Second: A program based on the use of augmented reality technology for the development of multiple intelligences (linguistic - social - mathematical logical - personal - natural intelligence ....) for children in early childhood.

The general objectives of the program

The program aims to identify:

- Developing linguistic intelligence among children in early childhood using augmented reality technology
- Developing logical-mathematical intelligence among children in early childhood using augmented reality technology
- Developing interpersonal intelligence among children in early childhood using augmented reality technology
- Developing intrapersonal intelligence among children in early childhood using augmented reality technology
- Developing naturalist intelligence among children in early childhood using augmented reality technology
- The effectiveness of using augmented reality technology to develop linguistic intelligence in children in the early childhood stage.
- The effectiveness of using augmented reality technology to develop logical and mathematical intelligence in children in early childhood.
- The effectiveness of using augmented reality technology to develop social intelligence among children in early childhood.
- The effectiveness of using augmented reality technology to develop intrapersonal intelligence in children in early childhood.
- The effectiveness of using augmented reality technology to develop children's natural intelligence in early childhood.

Procedural objectives

- The child chooses the picture that expresses the order of balls from the largest to the smallest.
- The child chooses the picture that expresses the correct pattern arrangement (triangle, circle, square, rectangle).
- The child chooses the correct meaning of number 12.
- The child chooses the correct picture expressing autumn.
- The child chooses the correct picture expressing the meaning of the word “heavy”.
- The child chooses the picture expressing the appropriate food for the parrot.
- The child chooses the picture of a bird eating insects.
- The child circles the picture of things that do not grow.
- The child chooses the picture of the bird eating fish.
- The child circles winter fruits.
- The child chooses the picture expressing the appropriate food for the elephant.
- The child chooses the dream job.
- The child chooses the picture of a surprised child.
- The child chooses the picture expressing the correct behavior to handle a cat.
- The child chooses the picture expressing the correct behavior in dealing with the elderly.
- That the child can express his feelings towards the pictures in front of you.
- To remind the child how to deal with the situations in front of him with pictures.
- The child should specify the profession he would like to work in in the future.
- To distinguish the image that expresses the correct behavior.
- Explain the differences between two similar images.
- To distinguish between children's expressions in the picture in front of him.
- To mention the picture that expresses the correct behavior in dealing with animals.
- To mention the picture that expresses the right behavior to deal with others.
- Arrange the shapes according to their size from largest to smallest.
- To be able to arrange things in the correct order.
- To distinguish between numbers and their meaning.
- To be able to verbally express in its entirety each picture in front of it.
- To mention the opposite of some things.
- To mention the appropriate food for each bird.
- To distinguish between things that grow and things that do not.
- To classify vegetables and fruits.
- To choose between the appropriate food for each animal with the type of food suitable for it.

Sources for building the program.

The researchers utilized the following sources for building the program:

- Research and studies on the stage and philosophy of kindergarten, characteristics of child development, and multiple intelligences and augmented reality in this stage
- Research and studies on developing a program for the kindergarten child using augmented reality.

❖ *Philosophy of the program*

To develop the program, the researchers adopted the theory of multiple intelligences by Gardner, according to which everyone has different types of intelligences and that intelligence represents a certain mental ability that requires a set of problem-solving skills to handle problems and difficulties. In this theory, Gardner mentions (7) intelligences, i.e., linguistic, logical- mathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal.

This study tackled some multiple intelligences, namely the linguistic, logical- mathematical, interpersonal, intrapersonal, and naturalist.

Target group:

A sample of (30) children between the ages of (5-6) enrolled in kindergartens affiliated to the Ministry of Education in Najran.

Program period

The program took (7) weeks, three days/ week. On each day, two different activities were offered using augmented reality. Each activity took (30) minutes from 29-2-1444 to 14-4-1444.

Place of program application:

The program was applied in the governmental kindergartens of the Department of Education in Najran. The activities were applied in the activity room in the kindergarten.

Program content:

The content of the program consisted of a set of activities using augmented reality technology. The researchers prepared the program to include (40) various activities using augmented reality to develop multiple intelligences (linguistic - interpersonal- logical-mathematical- intrapersonal- naturalist) for children in early childhood. The activities were three-dimensional authentic and semi-real pictures- illustrated pictures- illustrated books) related to multiple intelligences (linguistic - interpersonal- logical-mathematical- intrapersonal- naturalist) and using a tablet or mobile with an augmented reality program. When the camera was directed at the picture, it was translated into augmented reality. The child could move, minimize, and expand the picture and hear the sound of the object in the picture.

In sum, these are some foundations of the program:

- Familiarity between the researcher and the research sample
- Gradually moving from simple to complex concepts.
- The program's activities use (sound - picture- movement) from the natural environment.
- Using various reinforcement methods
- Reliance of the program's activities on the group and individual activities
- Appropriateness of the content to the qualities and needs of the children.

- Including activities and events that stimulate the children's interest.
- Considering the integration principle in the provided activities
- Effective contribution to developing multiple intelligences.

The techniques and methods of the program

- Instruction: Providing all kinds of support, especially sign and verbal
- Analyzing the task to decompose compound tasks into small executable parts.
- Modeling: Making a model for the children by directing the mobile camera at some pictures related to the program activities
- Role-playing: The teacher asks the child to repeat the presented activity.
- Reinforcement: The child is provided with verbal, material, and social reinforcement after the correct response.
- Feedback: The child is provided with corrections and illustrations of the information that could not be memorized.
- Individualized education: Treating the child according to individual differences
- Directing attention: Continuously drawing the child's attention through the augmented reality technology
- Brainstorming: An educational method that can be used with children. A learner thinks freely about an issue or problem to find the largest number of solutions with endless ideas. Then, the generated ideas are studied to get the best ideas without criticizing the other ideas.
- Discussion and dialog: A teaching method in which the teacher and child are in a positive situation; some pictures, an illustrated story, or an illustrated book are discussed with shared opinions between the children, classmates, and teacher. Then, the teacher corrects or approves the points discussed.
- Problem-solving: The teacher presents a problem to the children and asks them to find an appropriate solution. Thus, they discuss with each other.

Steps of applying the program

- Orientation: The teacher stimulates children's thinking at the beginning of the activity using some pictures or brainstorming to discuss the nature of augmented reality and how to transform images into augmented reality.
- Modeling: The teacher provides a model for presenting activities (three-dimensional authentic and semi-real pictures- illustrated pictures- illustrated books) using the camera of mobile with an augmented reality program to develop multiple intelligences to be developed among the children using dialog, discussion, and brainstorming.
- Guided practice: The teacher asks the child to repeat the activities with or after her directly.
- Independent practice: The teacher asks the child to do the activity independently to do it well.
- Application: The child can apply the acquired concepts to a new situation.
- Assessment: The teacher uses assessment activities to ensure achieving the program's activities.

Program duration:

The duration of the program ranges from 7 weeks, with three days of each week, and each day offers two different activities using augmented reality, starting from 29-2-1444 AH to 14-4-1444 AH.

Where to apply the program:

Applied in the kindergartens of the Ministry of Education in Najran, the activities were applied in the activity rooms inside the kindergarten.

Program time plan:

Table 5: shows the time plan for the program.

Dimensions	Day	Date	No of activities	Place of activity	Duration
Linguistic intelligence	Sunday	29/02/1444	2	Activity room	60 Min
	Tuesday	01/03/1444	2	Activity room	60 Min
	Wednesday	02/03/1444	2	Activity room	60 Min
	Sunday	06/03/1444	2	Activity room	60 Min
Social Intelligence	Tuesday	08/03/1444	2	Activity room	60 Min
	Wednesday	09/03/1444	2	Activity room	60 Min
	Sunday	13/03/1444	2	Activity room	60 Min
	Tuesday	15/03/1444	2	Activity room	60 Min
Logical mathematical intelligence	Wednesday	16/03/1444	2	Activity room	60 Min
	Sunday	20/03/1444	2	Activity room	60 Min
	Tuesday	22/03/1444	2	Activity room	60 Min
	Wednesday	23/03/1444	2	Activity room	60 Min
Intrapersonal intelligence	Sunday	27/03/1444	2	Activity room	60 Min
	Tuesday	29/03/1444	2	Activity room	60 Min
	Wednesday	01/04/1444	2	Activity room	60 Min
	Sunday	05/04/1444	2	Activity room	60 Min
Natural intelligence	Tuesday	07/04/1444	2	Activity room	60 Min
	Wednesday	08/04/1444	2	Activity room	60 Min
	Sunday	12/04/1444	2	Activity room	60 Min
	Tuesday	14/04/1444	2	Activity room	60 Min

Methods and tools used in the program:

Pictures of different forms and situations related to the multiple intelligences (linguistic - social - mathematical logical - personal - natural) of the child in early childhood, cards - sketches - colors - clay - cut and paste - puppets in different shapes.

Calendar tools used in the program:

The tribal evaluation that is carried out before applying the program through the scale prepared by the two researchers to identify the children's cognitive background about the dimensions of the multiple intelligences (linguistic - social - logical-mathematical - personal - natural intelligence ....) for the child in the early childhood stage.

The formative evaluation that takes place during the application of the program and is applied to all activities of the final evaluation that takes place after the completion of the application of the program. The scale is applied to the children to identify the effectiveness of the program and its impact on the study sample.

Program validity:

It was presented to a group of (11) reviewers to identify their opinions on the program's activities, appropriateness to the age group, and appropriateness to the objective. Accordingly, modifications were made, and the final form became applicable.

Procedures of the study

- Reviewing the relevant literature and preparing the theoretical framework and tools
- The tool, i.e., the illustrated test of multiple intelligences directed to children, was prepared after presenting to the reviewers and proofreader to ensure its appropriateness, phrasing, and ensuring validity and reliability.
- The Department of Early Childhood Education was mailed to facilitate the work of the researchers in applying the tools and materials to children.
- A pilot sample of (30) children was selected to apply the illustrated test and verify its validity and reliability.
- The illustrated test was applied to the main sample of children in Najran.
- An augmented reality-based program was prepared to develop multiple intelligences among children, besides selecting the appropriate activities for each intelligence and the means of implementing the activities.
- The program was applied to the study sample.
- Then, the test of multiple intelligences was applied to ensure the effectiveness of the program.
- Inserting and coding data in SPSS to be analyzed
- Statistical analysis of the data to answer the study questions.
- Discussing the results and making recommendations and suggestions

Statistical processing

The researchers used SPSS 25 for statistical processing using these methods.

- Pearson correlation coefficient
- Cronbach's alpha coefficient
- Arithmetic mean and standard deviation
- The Mann-Whitney test
- The paired samples T-test
- The effectiveness ratio equation by McGuigan

Implementation of the study experiment:

Experimental design and preparation of the research experiment: To achieve the objective of the study, the semi-experimental approach was followed, designing pre and post measurement for one group.

The practical procedures for implementing the study experiment included the following:

After completing the pre-application of the study tool, the two researchers applied the program in the period from 29-2-1444 AH to 14-4-1444 AH by implementing the activities of the program under study on the experimental group using augmented reality, at a rate of (3 hours) per week. The research tool (multiple intelligences scale) was applied after completing the application of the program on Tuesday 4/14/1444 AH on the basic study group on Wednesday and Thursday 4/16/15/1444 AH.

3 Results and Discussions

- ❖ The main research question:

The main question states: "What is the effectiveness of using augmented reality technology to develop multiple intelligences in children in early childhood?"
In order to answer the main question, the two researchers used the "T" test for linked samples (double), and the equation for the effectiveness ratio of MacGogian, who set a ratio of (0.6) to judge the effectiveness, and the results were as shown in Table (6):

Table 6: Significance of differences between the mean scores of the research sample children in the pre and post applications of the multiple intelligences test.

Scale application	Average score	standard deviation	t-test			Highest degree	effectiveness ratio
			T value	degrees of freedom	significance level		
Pre application	13.97	4.90	13.13	29	0.001	30	0.74
Post application	25.80	3.32					

Table (6) shows the results of the "T" test to indicate the differences between the mean scores of the research sample children in the pre and post applications of the multiple intelligences test, the average score of the children of the research sample in the pre-application was (13.97) and in the post-application (25.80), and the value of "T" was (13.13) and the level of significance was (0.001), which indicates that there are statistically significant differences between the two applications in favor of the post application, and the effectiveness ratio reached (0.74), which is a value greater than (0.6), and this indicates that the augmented reality technology used by the researcher was effective and led to the development of multiple intelligences among the children of the research sample.
Chart (1) shows this:

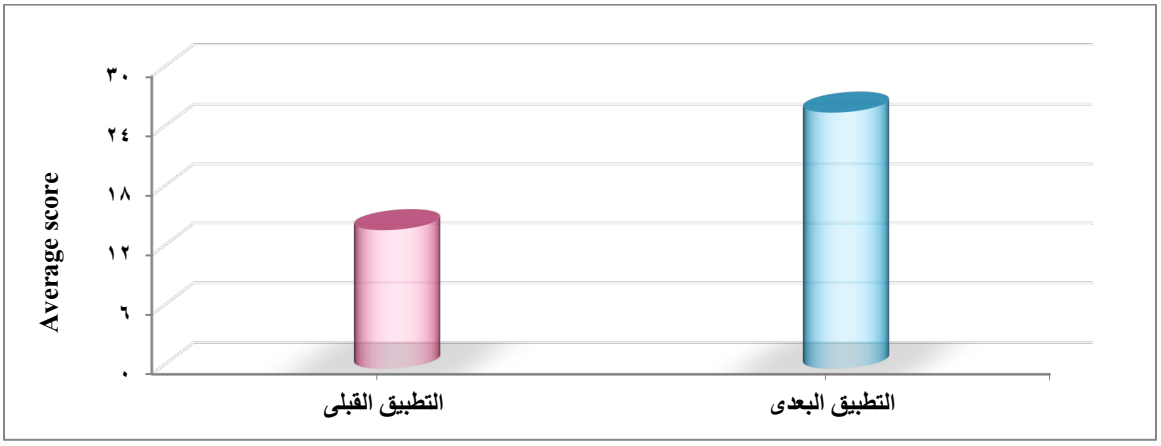

Fig. 1: shows the mean scores of the research sample children in the pre and post applications of the Multiple Intelligences test.

From table (6), its results, and chart (1), the main question of the research has been answered.

- ❖ The first sub-question of the research:

The first sub-question states, "What is the effectiveness of using augmented reality technology to develop linguistic intelligence in children in early childhood?"

In order to answer this question, the researcher used the "T" test for linked samples (double), and the equation for the effectiveness ratio of MacGogian, who set a ratio of (0.6) to judge the effectiveness, and the results were as shown in Table (7):

Table 7: The significance of the differences between the mean scores of the research sample children in the pre and post applications of linguistic intelligence.

Scale application	Average score	standard deviation	t-test			Highest degree	effectiveness ratio
			T value	degrees of freedom	significance level		
Pre application	2.87	1.07	12.23	29	0.001	6	0.72
Post application	5.13	0.78					

And chart (2) shows this:

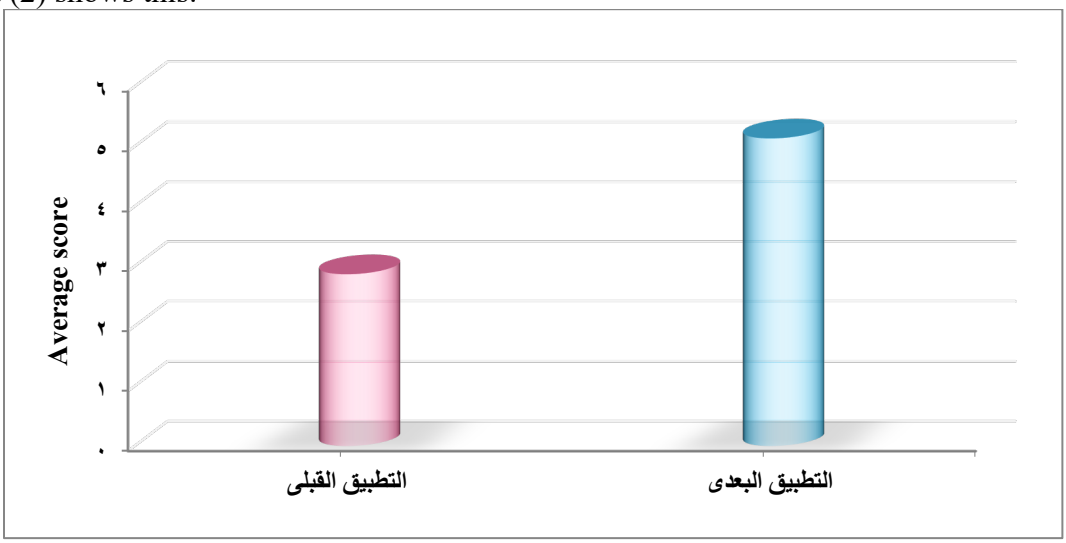

Fig. 2: shows the mean scores of the children of the research sample in the pre and post applications of

linguistic intelligence.

Table (7) shows the results of the "T" test to indicate the differences between the mean scores of the children of the research sample in the pre and post applications of linguistic intelligence. Where the average score of the children of the research sample in the pre-application was (2.87) and in the post-application (5.13), and the value of "T" was (12.23) and the level of significance was (0.001), which indicates that there are statistically significant differences between the two applications in favor of the post application. The effectiveness ratio was (0.72), which is a value greater than (0.6), and this indicates that the augmented reality technology used by the researcher was effective and led to the development of linguistic intelligence among the children of the research sample. This was confirmed by the study of both, Barreira et al., which aimed to measure the impact of language education for children through augmented reality games and that there are positive effects of the use of augmented reality on children, as the audio-visual media associated with technology helped children learn vocabulary, and the use of augmented reality was a very effective method, and it only requires a computer and a connection to the Internet [32], and Recep and Ekrem which aimed to identify the effectiveness of some current applications of augmented reality technology in language teaching at the primary level, and the study concluded that the use of augmented reality technology in language classes at the primary stage increased learners' performance and made vocabulary learning more effective compared to traditional methods [33].

The study of Redondo et al. aimed to assess whether the use of augmented reality in early childhood education improves learning of English as a foreign language, increases pupil motivation and helps children of this age to establish more positive social and emotional relationships. The study found a significant improvement in motivation, learning, and social and emotional relationships in the experimental group, who completed teaching where augmented reality was used as an educational tool, compared to the control group [34].

The two researchers attribute the existence of differences between the post-measurement and the pre-measurement of the experimental group in favor of the post-measurement to:

- The program's activities vary from (pictures - cards with attitudes - and stories...) based on augmented reality accompanied by audio-visual effects that excite and motivate the child to the educational process and increase his motivation to learn the language and new vocabulary, and his ability to use a variety of phrases to express his feelings and attitudes.
- Organizing and facilitating the activities of the program in accordance with the level of development of children's capabilities.
- Diversity in the evaluation methods used to ensure the achievement of the desired goals of the activities related to linguistic intelligence.

❖ The second sub-question of the research:

The second sub-question states, "What is the effectiveness of using augmented reality technology to develop logical-mathematical intelligence in children in early childhood?"

To answer this question, the researcher used the "T" test for linked samples (double), and the equation for the effectiveness ratio of MacGogian, who set a ratio of (0.6) to judge the effectiveness, and the results were as shown in Table (8):

Table 8: The significance of the differences between the mean scores of the research sample children in the pre and post applications of logical-mathematical intelligence.

Scale application	Average score	standard deviation	t-test			Highest degree	effectiveness ratio
			T value	degrees of	significance		

				freedom	level		
Pre application	2.73	1.14	10.85	29	0.001	6	0.78
Post application	5.27	0.87					

And chart (3) shows this:

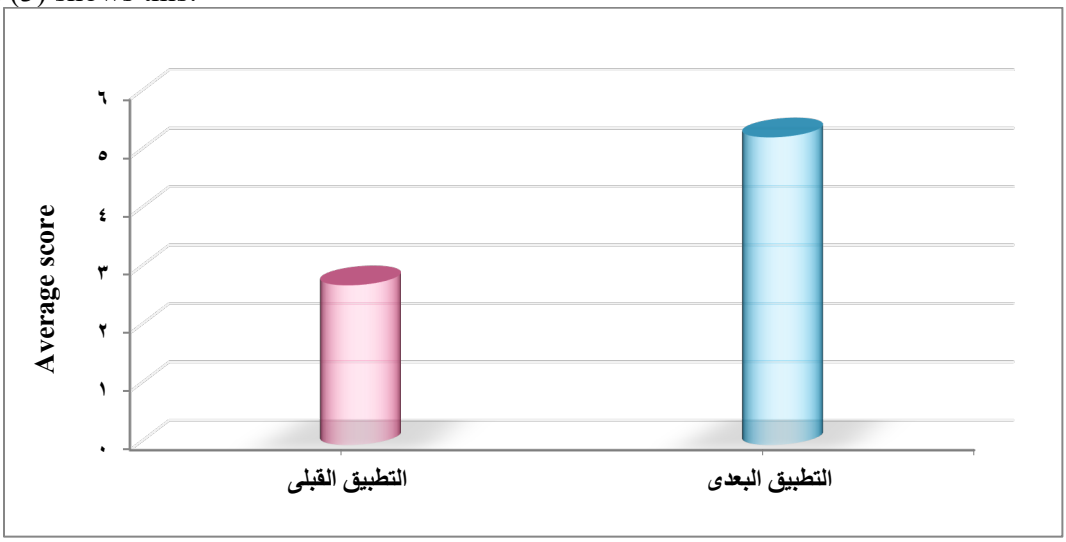

Fig. 3: shows the mean scores of the children of the research sample in the pre and post applications of logical-mathematical intelligence.

Table (8) shows the results of the "T" test to indicate the differences between the mean scores of the research sample children in the pre and post applications of logical-mathematical intelligence. The average score of the children of the research sample in the pre-application was (2.73) and in the post-application (5.27), and the value of "T" was (10.85), and the level of significance was (0.001). Which indicates that there are statistically significant differences between the two applications in favor of the post application, and the effectiveness ratio reached (0.78), which is a value greater than (0.6), and this indicates that the augmented reality technology used by the researcher was effective and led to the development of logical and mathematical intelligence among the children of the research sample.

This was confirmed by Wei et al., which aimed to discuss the educational design on how to use augmented reality games in the multimedia teaching environment. Based on the two theories, the paper came to the conclusion, that the experimental group in the environment of augmented reality has a better educational effect than the control group that implements the activity in the traditional learning environment and that the development of multiple intelligences for children is wonderful. The instructional design discussed in this study can have a positive effect on children's learning effects and can also promote the overall development of children's multiple intelligences [35].

The two researchers attribute the existence of differences between the post-measurement and the pre-measurement of the experimental group in favor of the post-measurement to:

- The program's activities vary from (cards for preparation - pictures of numerals of numbers ...) based on augmented reality accompanied by audio-visual effects that work to stimulate and excite the child for the educational process and increase his motivation for education and develop his thinking and problem-solving skills.
- Organizing and facilitating the activities of the program in accordance with the level of development of children's capabilities.

- Diversity in the evaluation methods used to ensure the achievement of the desired objectives of the activities related to the logical-mathematical intelligence.

❖ The third sub-question of the research:

The third sub-question states, "What is the effectiveness of using augmented reality technology to develop children's social intelligence in early childhood?"

In order to answer this question, the researcher used the "T" test for linked samples (double), and the equation for the effectiveness ratio of MacGogian, who specified a ratio of (0.6) to judge the effectiveness, and the results were as shown in Table (9):

Table 9: Significance of differences between the mean scores of the children of the research sample in the pre and post applications of social intelligence.

Scale application	Average score	standard deviation	t-test			Highest degree	effectiveness ratio
			T value	degrees of freedom	significance level		
Pre application	2.73	1.14	9.95	29	0.001	6	0.76
Post application	5.20	0.85					

And chart (4) shows this:

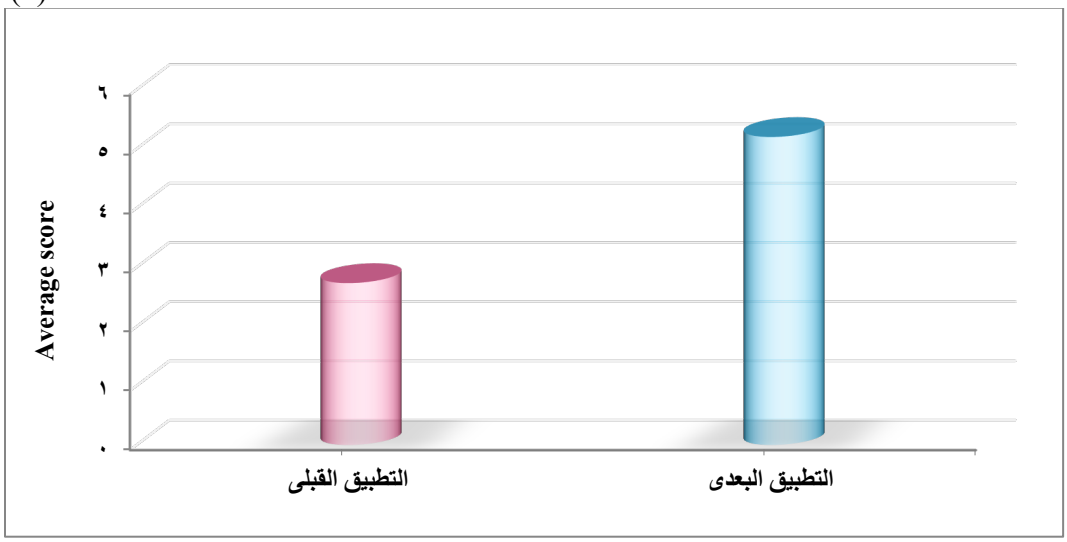

Fig. 4: shows the mean scores of the children of the research sample in the pre and post applications of social intelligence.

Table (9) shows the results of the "T" test to indicate the differences between the mean scores of the children of the research sample in the pre and post applications of social intelligence. The average score of the children of the research sample in the pre-application was (2.73) and in the post-application (5.20), and the value of "T" was (9.95), and the level of significance was (0.001). Which indicates that there are statistically significant differences between the two applications in favor of the post application, and the effectiveness ratio reached (0.76), which is a value greater than (0.6), and this indicates that the augmented reality technology used by the researcher was effective, and led to the development of social intelligence among the children of the research sample. This was confirmed by the study of Goktas and Yilmaz which aimed at analyzing picture books equipped with augmented reality technology for storytelling in preschool children, which showed that children felt overjoyed and very interested during this activity, and expressed their enjoyment of these books. They considered it a magical world, and in addition, their understanding of the story had greatly improved [36].

The two researchers attribute the existence of differences between the post-measurement and the pre-measurement of the experimental group in favor of the post-measurement to:

- The program's activities vary from (cards for social situations - pictures of professions - stories) based on augmented reality accompanied by audio-visual effects that work to excite and motivate the child to the educational process and increase his motivation for education and develop the social aspect of the child in his dealings with others.
- Organizing and simplifying program activities in line with the level of development of children's capabilities.
- Diversity in the evaluation methods used to ensure the achievement of the desired goals of activities related to social intelligence.

❖ The fourth sub-question of the research:

The fourth sub-question states, "What is the effectiveness of using augmented reality technology to develop children's intrapersonal intelligence in early childhood?"

In order to answer this question, the researcher used the "T" test for linked samples (double), and the equation for the effectiveness ratio of MacGogian, who set a ratio of (0.6) to judge the effectiveness, and the results were as shown in Table (10):

Table 10: Significance of differences between the mean scores of the research sample children in the pre and post applications of intrapersonal intelligence.

Scale application	Average score	standard deviation	t-test			Highest degree	effectiveness ratio
			T value	degrees of freedom	significance level		
Pre application	2.90	1.30	8.53	29	0.001	6	0.70
Post application	5.07	0.74					

And chart (5) shows this:

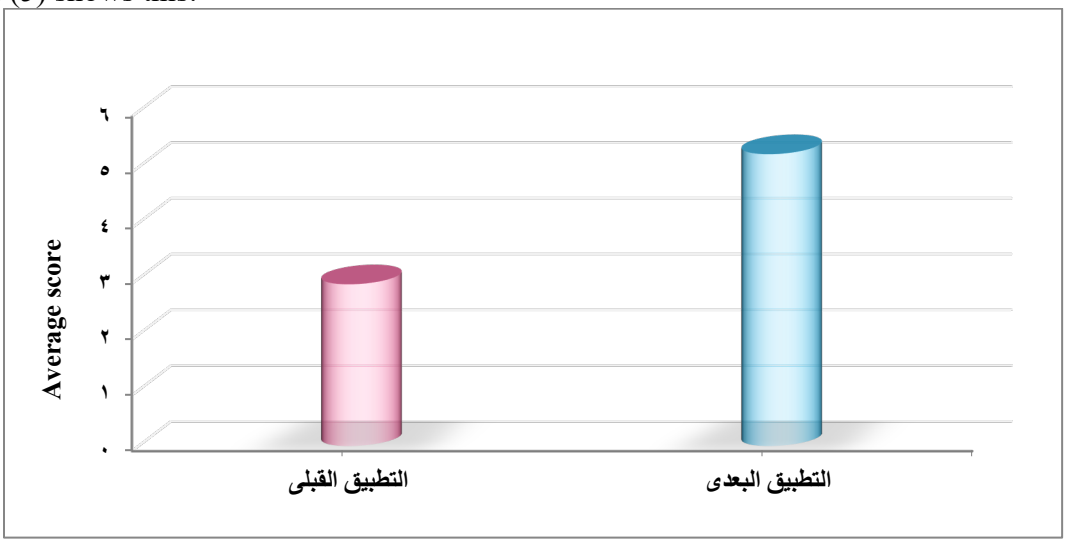

Fig. 5: shows the mean scores of the children of the research sample in the pre and post applications of intrapersonal intelligence.

Table (10) shows the results of the "T" test to indicate the differences between the mean scores of the children of the research sample in the pre and post applications of intrapersonal intelligence. The average score of the children of the research sample in the pre-application was (2.90) and in the post-application (5.07), and the value of "T" was (8.53) and the level of significance was (0.001). Which indicates that

there are statistically significant differences between the two applications in favor of the post application, and the effectiveness ratio reached (0.70), which is a value greater than (0.6), and this indicates that the augmented reality technology used by the researcher was effective, and led to the development of intrapersonal intelligence among the children of the research sample.

This was confirmed by Ashreia' study which aimed to find out the effect of a proposed self-learning program for the experiences curriculum for pre-schoolers in Khartoum state, on the development of the eight main multiple intelligences [37]. It also aimed to identify the differences in the development of the multiple intelligences of the children to whom the program was applied, on the impact of the proposed self-learning program on the development of the multiple intelligences of the children of the experimental group after applying the program:

The two researchers attribute the existence of differences between the post-measurement and the pre-measurement of the experimental group in favor of the post-measurement to:

- The program's activities vary from (cards for social situations - pictures of different shapes) based on augmented reality accompanied by audio-visual effects that work to excite and motivate the child to the educational process and increase his knowledge of himself and others.
- Organizing and facilitating the activities of the program in accordance with the level of development of children's capabilities.
- Diversity in the evaluation methods used to ensure the achievement of the desired goals of the activities related to intrapersonal intelligence.

❖ The fifth sub-question of the research:

The fifth sub-question states, "What is the effectiveness of using augmented reality technology to develop children's natural intelligence in early childhood?"

In order to answer this question, the researcher used the "T" test for linked samples (double), and the equation for the effectiveness ratio of MacGogian, who set a ratio of (0.6) to judge the effectiveness, and the results were as shown in Table (11):

Table 11: Significance of differences between the mean scores of the research sample children in the pre and post applications of natural intelligence.

Scale application	Average score	standard deviation	t-test			Highest degree	effectiveness ratio
			T value	degrees of freedom	significance level		
Pre application	2.73	1.11	11.93	29	0.001	6	0.73
Post application	5.13	0.82					

And chart (6) shows this:

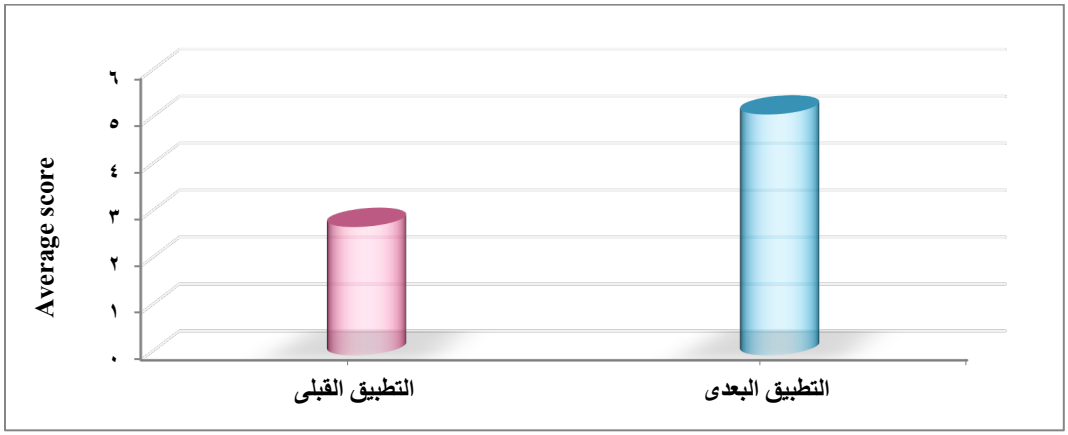

Fig. 6: shows the mean scores of the children of the research sample in the pre and post applications of natural intelligence.

Table (11) shows the results of the "T" test to indicate the differences between the mean scores of the children of the research sample in the pre and post applications of natural intelligence. The average score of the children of the research sample in the pre-application was (2.73) and in the post-application (5.13), and the value of "T" was (11.93) and the level of significance was (0.001). Which indicates that there are statistically significant differences between the two applications in favor of the post application, and the effectiveness ratio reached (0.73), which is a value greater than (0.6), and this indicates that the augmented reality technology used by the researcher was effective, and led to the development of natural intelligence among the children of the research sample.

This was confirmed by the study of both Al-Ashry (2005), which aimed to identify the effectiveness of the proposed program in developing the natural intelligence of children and reached the effectiveness of the proposed program in developing the natural intelligence of the members of the experimental group, and Qarbouni, (2014), which aimed to identify the impact of employing and measuring the impact of reality applications in acquiring scientific concepts for children on the impact of augmented reality technology on preschool children's retention of the scientific concepts they gained.

The two researchers attribute the existence of differences between the post-measurement and the pre-measurement of the experimental group in favor of the post-measurement to:

- The program's activities vary from (cards – pictures of different shapes) based on augmented reality accompanied by audio-visual effects that work to excite the child in the educational process and increase his motivation for education and understanding of the environment around him and develop his problem-solving method and how to deal with nature.
- Organizing and facilitating the activities of the program in accordance with the level of development of children's capabilities.
- Diversity in the evaluation methods used to ensure the achievement of the desired goals of the activities associated with natural intelligence.

4 Conclusions and Recommendations

The study aimed to measure the effectiveness of using augmented reality technology to develop multiple intelligences, namely the linguistic, logical- mathematical, interpersonal, intrapersonal, and naturalist, in children in early childhood. Considering the results of the study, the researchers recommends the following – to direct those in charge of preparing kindergarten curricula to include augmented reality technology in kindergarten curricula - to direct the attention of kindergarten teachers to the use of augmented reality technology in the development of multiple intelligences – to direct kindergarten teachers to the diversity of methods and strategies used to develop multiple intelligences.

Conflicts of Interest Statement

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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