

Gestures-based Electronic Educational Games and their Impact on the Usability at Primary School Pupils

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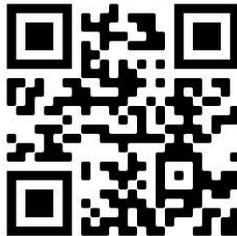
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Abstract:

The advent of gesture-based technology and gesture recognition devices has opened doors for a new generation of educational games that allow for more natural interfaces that are closer to the tasks that are actually being performed.

Usability is a controversial issue in the field of human-computer interaction, yet more research is still needed to understand user behaviors of systems and environments that rely on multimedia, in order to help designers and developers build natural, robust and appropriate user interfaces, The user-centered design methodology is the most popular method for designing that interaction and building better, more appropriate user interfaces.

The current research aimed to using electronic educational games based on gestures and measuring their impact on the usability of elementary school students by preparing a usability scale consisting of (6) dimensions: the purpose of the games, impression, ease of use, content, navigation and interaction, visual design, And the need for educational games based on gestures, and the current research used the experimental method, where the research applied to one experimental group consisting of (30) pupils in the third grade of primary school. The results showed that pupils scored higher on the usability scale and exceeded the specified level of usability.

Key words: Electronic Educational Games, Gestures-based Learning, Usability

Introduction:

Gesture-based technology enables learners to participate physically and actually in learning as the use of body gestures and movements as input provides opportunities for experiential practical learning that relies heavily on practical experiences. Thus, gesture-based technology is an enabling or auxiliary technology for physical learning, Moreover, the inclusion of the body the body in an educational activity that has the ability to enhance experiential learning, unlike traditional interfaces that rely on virtual reality or computer simulations where learners learn practical experiences without body movement (Johnson et al, 2012).¹

With these advantages available, many studies have used gesture-based technology as an auxiliary technology in the educational process, such as classroom instruction (Chang et al. 2013), memory enhancement (Chao et al. 2013), physical or therapeutic rehabilitation (Chang et al. al. 2011b), physical education (Vernadakis et al. 2012), vocational training (Chang et al. 2011a), and language learning (Kuo et al. 2014; Chang et al. 2014).

Gesture-based learning is a multimedia environment capable of facilitating interaction with and coordination between auditory and visual information, and coordinating these different interactions makes the learning environment support students with different learning styles and methods that depend on the perceptual channels or pathways through which individuals can send, receive and store information, Imagination, remembering, feeling, and connecting concepts (Hsu, 2011b, p. 365).

Electronic educational games are also an integrated

¹ The American Psychological Association (APA) sixth-generation documentation system was used, with the name indicating the author, then the year of publication, then the page.

educational environment that focuses on the learner, and provides him with the opportunity for social communication and an opportunity to solve problems without the intervention of the teacher, and they also work to provide a social and cultural context for learning, these advantages of electronic educational games are helpful factors to stimulate the desire to learn among the learner, as well as They provide a lively, active and exciting environment for the learner (Uzun, 2010, pp. 45-59).

The integration of gesture-based technology with electronic educational games has a significant impact on improving learning outcomes, as a study conducted by Hsiao and Chen (2016) using a Kinect sensor-like device to know the effect of gesture interactions in play-based learning on learning performance And motor skills of pre-school children. The results of the study showed that the system improved the learning performance of children as well as their motor skills compared with learning based on traditional play activities.

Many studies also emphasized the importance of gesture-based educational games in the educational process, such as the study of (Altanis, Boloudakis, Retalis, & Nikou, 2013; Chao, Huang, Fang, & Chen, 2013; Lee, Huang, Wu, Huang, etc.) & Chen, 2012; Li, Wang, Wu, & Chen, 2014; Lu, Liu, Chuang, & Peng, 2012; Wu, Huang, & Chang, 2013; Hsiao & Chen, 2016; Sheu & Chen, 2014), On the other hand, usability is one of the most important features of software, and usability is usually associated with it in order to know the extent of users' interaction with the system, and measuring usability has become a very important matter, Because it works to provide a set of results based on quantitative and qualitative estimates that help in the software development process (Gonzalez & Granoller, 2008, p. 247).

In this context, the study (Flowers, 2006) refers to usability testing as a suitable tool for critiquing and analyzing products and

projects, it helps to get an objective view of the user interface of a particular design by engaging and exploring.

Due to the increased market demand for systems with gesture interaction, it became necessary to establish procedures to assess the usability of these interfaces in order to reduce problems during interaction. In this regard, the study (Keskinen, et al, 2013) proposed a method for evaluating the user experience of interactive systems, and the study (Rautaray, et al, 2014) presented comparative studies that described the elements of gestural interaction, and the study (Maidi, et al, 2013) organized how to evaluate gestures. However, it is difficult to come to a consensus among these studies as to what should or should not be evaluated, especially when it comes to assessing the usability of the gestural interaction used in games.

Feeling the problem:

Sense of the research problem stemmed from the following sources:

- Although electronic educational games have made great achievements in education, there are still some shortcomings where the use of a mouse, keyboard and touch screen does not lead to the actual experience of natural human-machine interactions, which differs completely with learning based on gestures, Which provides an opportunity for real and flexible interaction with the learning environment.
- It was noted that there was no Arab study that dealt with the research of educational games based on gestures and their usability as far as the two researchers know, despite the confirmation of many foreign studies on the effectiveness of gesture-based learning in various aspects of education, such as the study: Johnson-Glenberg & Megowan-Romanowicz, 2017; Hsiao & Chen, 2016 ; Kuo et al. 2014; Chang et al. 2014; Sheu & Chen,

2014; Smith et al., 2014; Ayala, Mendívil, Salinas & Rios, 2013; Chang, et al. 2013; Chao, et al. 2013; Hsu et al. 2013; Kirsh, 2013; Meng et al. 2013; Sommoool, Battulga, Shih & Hwang, 2013; Shih-Ching, et al., 2012; Vernadakis, et al. 2012; Chang et al. 2011b). It was also noted the scarcity of foreign studies that dealt with measuring the usability of gesture-based educational games especially at primary school pupils.

- Recommended some Arab conferences such as the first scientific conference of the Department of Educational Technology and the fourteenth of the Arab Society for Educational Technology (2018): titled “The Competitive Advantage of Educational Technology Research. Smart Learning Systems”, and the Second International Conference of the Faculty of Specific Education, Minia University (2019): titled “Quality Education ... innovation and the labor market, "with the importance of employing gesture-based technology in the educational process.

Research problem:

The research problem was represented in revealing the effect of using gestures-based electronic educational games on the usability at primary school pupils, so the current research tries to address this problem by answering the following question:

“What is the effect of gestures-based electronic educational games on the usability at primary school pupils?”

Research hypotheses:

There is a statistically significant difference at the level of (0.05) between the calculated average of the research sample in the scores of the usability scale and the level (90%) of the total score of the scale in favor of the research group.

A usability ratio (90%) has been set as a default for two reasons, firstly, that the quality standard extends from (85%) to

(90%), and secondly, the current research used a one-group experimental design.

Research objective:

The current research sought to use electronic educational games based on gestures, to reveal their impact on the usability of elementary school pupils, and to determine the degree of student acceptance of the use of gesture-based technology and the factors that must be taken into account so that this gesture-based technology is easy to use.

Research importance:

- 1- Enriching the teaching and learning process to keep pace with the technological development in the field of education.
- 2- This research may contribute to covering the shortage of Arabic studies that dealt with gesture-based educational games.
- 3- Encouraging decision-makers in the educational process at the primary stage to replace traditional educational games with gesture-based games to contribute to eliminating the problem of Arab education systems remaining poorer in using modern technologies in the teaching and learning process.

Search limits:

The current search was confined to:-

- 1- **Human limits:** The research group included the third grade pupils of primary school, from the primary language school, the Mina educational administration, and their number reached (30) pupils this is because the games are suitable for this age group.
- 2- **Content limits:** The concepts and arithmetic operations included in mathematics for the first three grades of the elementary school, such as: (ascending order, number and pronunciation, addition, subtraction, multiplication, and division).
- 3- **Temporal limits:** The research was applied in the second semester of the academic year (2019/2020).

Research Methodology:

This research followed the descriptive approach in collecting and classifying information and resources necessary to build the theoretical framework and research tools, and the quasi-experimental approach in conducting the research experiment through the use of gestures based electronic educational games and knowing their impact on usability, where the experimental design with one group was used.

Research variables:

The search included the following variables:-

- 1-The independent variable: Gesture-based Electronic Educational Games.
- 2- The dependent variable: Usability.

Experimental design:

The research group was selected from third grade primary pupils, and it relied on the experimental design of one group.

The research sample:

A random sample was selected from the third grade of primary school pupils from the primary language school, consisting of (30) pupils, as well as those who have a desire to participate in the research experiment in addition to the availability of the necessary resources to implement the experiment in the school.

Research tool:

The tool used in the research was the Usability Scale.

Experimental treatment material:

The experimental treatment material was ready-made gesture-based electronic learning games downloaded from the Internet for free.

Research terms:-

Gesture based electronic educational games:

Procedurally defined as: electronic educational games that have an educational goal and an entertaining goal that the learner interacts with by moving his hands or feet, and the educational goal is to develop concepts and mathematical operations for elementary school pupils, and the entertainment goal is to excite the pupils and provide an enjoyable and interactive educational environment.

Usability:

Procedurally defined as: the learner's ability to interact with electronic learning games based on gestures easily and quickly through whole-body movements to accomplish the required educational tasks with effectiveness, efficiency, satisfaction, learning ability and control.

Theoretical framework and previous studies:

The current research aims to use electronic educational games based on gestures and study their impact on the usability of primary school pupils. Therefore, the theoretical framework of the research deals with two axes, namely: electronic educational games based on gestures, and usability.

The first chapter - Gesture based electronic educational games:

Morley and Folmer define (Morelli T, Folmer E, 2014, pp. 83-90) gesture-based educational games as games that simulate

real physical activities and rely on whole-body gestures.

Ribeiro and Duarte (Ribeiro A, Duarte C., 2012, p. 2) also define them as easy-to-play games automatically that allow natural interaction and immersion, and provide different forms of group and individual interaction, and this interaction is done through different input devices to sense movement.

Advantages of gesture based electronic educational games:

Gesture-based educational electronic games combine the advantages of play-based learning with the advantages of gesture-based technology (Ibáñez, J. & Wang, A, 2015, p. 26; Johnson, Levine, Smith, & Stone, 2010), and can be summarized in what: Follows:

- 1) Providing more natural user interfaces that are closer to the task to be achieved
- 2) It provides new ways to interact with the course content.
- 3) It allows students to use their bodies while playing, which reduces physical negativity.
- 4) Supports students who learn better through the motor learning style.
- 5) It provides the opportunity to learn complex concepts and provides more realistic learning.

Importance of gesture based electronic educational games:

Several studies have emphasized the importance of gesture-based educational games in the educational process, such as the study of (Altanis, Boloudakis, Retalis, & Nikou, 2013; Chao, Huang, Fang, & Chen, 2013; Lee, Huang, Wu, Huang, & Chen, 2012; Li, Wang, Wu, & Chen, 2014; Lu, Liu, Chuang, & Peng, 2012; Wu, Huang, & Chang, 2013; Hsiao & Chen, 2016; Sheu & Chen, 2014) and can be summarized in the following:

- 1- Strengthen memory.
- 2- Understanding the educational materials better.

- 3- Strengthening motor skills by supporting the motor learning style.
- 4- Increasing the activity of the learner.
- 5- It helps teachers to observe learners while performing educational tasks.
- 6- To obtain direct feedback.
7. Increase engagement in learning.
- 8- Helping students learn better through movement.
- 9- It allows students to practice physical activity during the school day.
- 10- It allows students to learn different skills such as thinking skills.
- 11- Spatial capacity development.
- 12- Improving teachers 'ability to display multimedia in an exciting manner and create opportunities for interaction and discussion.

Basic elements of gesture based electronic educational games:

E-learning games and e-learning games based on gestures share the same elements: (Hsiao & Chen, 2016, p. 153; Ibáñez, J. & Wang, A, 2015, p. 30)

- 1) Goals: It is the end that the player wants to reach, so the goal of the game must be clearly defined, and we should distinguish between the goal of the game itself, which is to gain and the educational goal, which is what we want the learner to learn from the game.
- 2) Rules: Every game should have rules that determine how to play.
- 3) Competition: It depends on the element of competition and is between one person and another or the person and himself.
- 4) Challenge: It is considered the most important element of attraction and excitement in the games, and it is answered that the

game includes an appropriate amount of challenge that provokes the capabilities of the learner within possible limits.

5) Fantasy: the game relies on imagination to encourage learning.

6) Safety: The game is a non-hazardous environment where the student feels safe and not afraid.

7) Entertainment: The game must achieve the element of entertainment and pleasure, provided that this is not the goal of the game, but rather the balance between fun and learning must be taken into account.

8) Adaptation: You must take into account the different learning styles of students, the difference in their previous information, and the difference in their expectations and goals.

9) Triggers and positive response: The educational situation in the electronic game that is presented to the learner is exciting and requires a positive response in order to move to a new step.

10) Feedback and immediate reinforcement Feedback: Since the learner has responded to the stimulus, so the educational game displays the immediate result and serves as reinforcement for the learner that pushes him to continue playing.

The factors to consider when designing gesture based electronic educational games:

Both (Bartoli et al., 2014, Hamilton et al., 2013) believe that in order for educational games to be successful; they must meet several conditions, which can be summarized as follows:

1) The availability of a set of rules and laws to set the game.

2) The availability of an element of suspense and excitement.

3) The availability of the profit and loss component at the end of the game.

4) Using color, images and movement to maintain student interest and desire.

5) The game should be suitable for the level of the child which is presenting to him.

- 6) It must be based on principles that represent and reflect the concept or skill to be taught.
- 7) That the success is a result obtains by the learner upon demonstrating his ability to master the concept or the skill to be learned.
- 8) The learner should be aware of the skills and concepts that he must master and not just learn how to play this game.
- 9) To be simple in levels and graphics and easy to navigate within the game.
- 10) The objects on the screen should move slowly to give the student a chance to interact with them.
- 11) Reducing the number of procedures required of the student at one time.
- 12) Balancing effort and individual differences between students.
- 13) Does not require accurate timing and avoid the need to make precise movements at a specific time.
- 14) Reducing the penalty of mistakes and not making fun of the student for mistakes.

Chiu and Fu (Chiu & Fu, 2018, pp. 68-69) and Bianchi (Bianchi-Berthouze 2013, pp. 40-75) added that it is important to distinguish between whether gestures are to be used as controllers or as a means to help students learn, They indicated a range of factors that must be taken into account when designing the gestures:

- 1) Designing gestures as look like real life.
- 2) Designing easy gestures and memorable.
- 3) Designing gestures within the games vary according to their purpose.
- 4) Take into account the lack of similarity between the gestures to prevent errors.

In this regard, Wu (Wu, 2015, pp. 4-5) points to the need to pay attention to the sound element, as sound is a very influential element in game design and is linked to the memory of the

learner, to the extent that a simple shape on the screen can suddenly gain weight, texture and resistance based on signals Specific phoneme.

As Papworth (Papworth, 2010, pp. 1-8) also indicated that sound provides information that arouses the feelings of learners and increases the degree of realism that visual images cannot do. For example, individuals can recognize some elements such as surface, friction and weight, through stimuli Vocal.

The second chapter - The Usability:

Usability is the diversity and degree to which the system can be used efficiently so that the user can perform tasks effectively and intuitively and achieve a balance between functionality and ease of use and thus achieve system effectiveness (Karray, et al, 2008, pp. 137-159).

Both Lee and Kozar (Lee & Kozar, 2012, p. 451) define it as the ability of individuals to use and interact with an electronic product to achieve specific goals with satisfaction, potency, and efficiency in a specific context of use.

Alshamari and Mayhew (Alshamari & Mayhew, 2009, p. 402) both assert that usability means efficiency, effectiveness, and user satisfaction, and that the differences between definitions depend on the characteristics of each system.

The importance of usability:

Reactive systems can only be considered useful and practical if they are well used, as the study of (Komlódi et al, 2011; Legouverneur et al, 2011; Francese et al, 2012; Norouzi-Gheidari et al, 2013; Liu et al, 2014; Shin et al, 2014; Fang et al, 2015; Harrington et al, 2015; Nakai et al, 2015; Sheu et al, 2015; Simor. Et al, 2016) confirmed on the importance of usability as it illustrates efficiency of the system, and its effectiveness and consequently the success of The system or its failure, and the level

of satisfaction that the user feels while using the system, as the system in which the usability is not good reduces the performance of the user within the system and negatively affects the desire of individuals to purchase and use it, and then the usability is considered one of the main pillars in the field of interaction between the Human and the machine, through an interface that allows the user to interact with the system.

Advantages of usability:

Nielsen (Nielsen, 2009, P. 22); (Nielsen, J, 2012) and Tractinsky (Tractinsky et.al, 2008, pp. 24-25) and Karahoca and Karahoca (Karahoca & Karahoca, 2009. P. 372) were that the most important advantages of usability for any e-learning environment are:

- 1- It helps the learner to navigate successfully within the environment.
- 2- It helps the learner in identifying the strengths and weaknesses in designing the environment.
- 3- It helps the learner to perform the basic tasks in the least possible time and with ease, thus the learner arrives at a feeling of satisfaction.
- 4- It helps to regulate the environment and its components and elements.
- 5- Provides clarity and simplicity.
- 6- It shows the extent to which the task was accomplished efficiently, effectively and accurately.
- 7 - Determine the extent of the success of the environment and its achievement of objectives.
- 8- It increases performance within the environment and allows for natural interaction and immersion.
- 9- Determining the quality of the interactive system and the quality of the interaction.
- 10- Ease of resetting the system when errors occur.

11- Balance between functionality and ease of use.

Usability characteristics:

Usability in gesture-based systems has a number of important characteristics, and among these characteristics Nelsen (Nielsen, J, 2012) identified is: ease of performing basic tasks, efficiency when performing these tasks, ease of reuse, and resetting the system when errors occur. And satisfaction with use.

Both of (Thowfeek & salem, 2014, p. 920; Shih, Huang & Chen, 2013. pp. 344-345; Rodrigues Pendo, et.al, 2012, p. 102; Yengin, Karho; a & Karhoka, 2011, p. 1400; Zaharias & Koutsabasis, 2011, p. 49; Granic, 2008, p. 214; Hee Kim & Ho Kim, 2008, p. 868; Nokelainen, 2006, pp. 196-197) mention Several basic characteristics of usability in any E-learning environment, including:

- 1- Effectively: It means the ability of the system to achieve the goals and bring about the required learning.
- 2- Efficiency: it means the system's ability to achieve the goals with the required speed and with the fewest errors.
- 3- User properties: It means that the system is designed to suit the user's characteristics and to achieve comfort and satisfaction.
- 4- Ease of learning: it means that the system is characterized by ease and helps the user to complete the required tasks.
- 5- Comfort and Satisfaction: that is, the user's feeling of comfort, satisfaction and pleasure when using the system.
- 6- Memorability: It refers to how easy it is for the user to recall the information after a period of time and to remember how to complete the required tasks while using the system after a period of use. The ability to remember is measured by the number of errors that the user makes while completing the task after learning how to accomplish the task In light of this, the ability to remember information is related to certain factors, including interface elements that help to remember information and deal with the

environment and use it easily.

7- Clearness & Simplicity: It means that the system should be designed so that it is clear and simple by focusing on the unity of the subject so that it can be used well.

8- Learnability: It refers to the ease with which the user can accomplish the tasks required of him by dealing with the system. The ability to learn is measured by the time spent in completing and achieving the required tasks and the number of errors during the completion of the task. Therefore, the learning capacity has to do with the design of the system interface.

It is evident from the above that the characteristics of the usability of gesture-based systems are related to the user's ability to take advantage of the system, so the more the system is able to meet the needs and requirements of the user, the degree of utility the system and its use.

Usability assessment:

The continuous development of usability assessment mechanisms occurs due to the rapid development and spread of interactive systems in the market, providing the user with new ways to interact (Simor et al, 2016).

Usability assessment is necessary to know the relationship between the quality of the interactive system and the quality of the interaction, and in this regard researchers in the field of human-computer interaction have developed several methods for assessing usability in order to determine whether the interactive system or device is usable or not (Cockton G, 2012).

Given the increased market demand for systems with gesture interaction, it became necessary to establish procedures for assessing the usability of these interfaces in order to reduce problems during interaction, and in this regard (Keskinen, et al, 2013, p. 7) suggested a method for evaluating the user experience of systems. (Rautaray, et al, 2014, pp. 57--65) presented

comparative studies that described elements of gestational interaction and organized (Maidi, et al, 2013, pp. 1812--1815) how to evaluate gestures. However, it is difficult to reach a consensus in Opinions among these studies as to what should or should not be evaluated, particularly when it comes to assessing the usability of gestural interaction used in games.

Usability scale:

The Usability Evaluation Methods (UEMs) are generally defined as a procedure consisting of a set of well-defined activities to collect usage data related to the end user's interaction with the electronic product, and the specific characteristics of that product that help achieve a certain degree of ease of use, Usability assessment methods have evolved to include a method called WIMP, which is an acronym for (Window - Icon - Menu - and Poin Device) which are the most representative elements of interfaces of applications use (Fernandez, Insfran & Abrahao, 2011, p. 790).

Both of (Fernandez, Abrahao & Insfran 2011, p. 720; Alshamari & Mayhew, 2009, p. 403; Hwang & Salvendy, 2009, p. 289; Gonzalez, Lores & Granollers, 2008, pp. 550-551; Folmer & Bosch, 2004, p. 70) Classifies Methods and tools for assessing employability in general fall into three main categories, including: Testing Methods, Inspection Methods, and Inquiry Methods.

The following is a review of studies that dealt with assessing the usability of gesture-based systems and the various tools that each study used in the process of assessing usability. Some of them provided qualitative results, others provided quantitative results, and some focused on measuring satisfaction or acceptance, and some took into account physiological measures.

The study of (Francesse et al, 2012) aimed to evaluate two games that were designed for three-dimensional interaction, and the games used were Wing for the Wii and King for Kinect, and the main goal was to evaluate gesture interaction through the user's ability to control navigation through device Kinect and Wii, 24 volunteers from staff and students from the University of Salerno in Italy participated in the experiment, and their ages ranged from 18 to 41 years, and each participant answered 12 questions, using a seven-point Likert scale, and three factors were evaluated: participation, entertainment and control, as well as The researchers used the Computer System Usability Questionnaire (CSUQ), which consisted of 19 questions, to assess the extent of user satisfaction with the game for four factors: overall rating, system quality, information quality, and interface quality. The results of the experiment were positive and confirmed the results of the evaluation that were conducted through The questionnaire is that if the interface is more natural, the user will be satisfied and engaged in navigation within the game.

The study of (Liu et al, 2014) evaluated the usability of a game they developed using the Kinect device. The researchers randomly selected six volunteers, aged between 50 and 88 years, and the evaluation went through three stages: presenting a brief about the game, using the game, and interviews to collect their comments. Where users answered a list of open questions and provided some suggestions to improve the design of the game, and as for the results, all users showed great interest in the game and gave a good evaluation of it.

The study of (Shin et al, 2014) aimed to combine gesture rehabilitation exercises with electronic game elements using sensor technology, through the Kinect device, and researchers at Hanyang University in Seoul, South Korea, conducted an experiment on stroke patients to assess the system's usability, and the study focused on Three factors in the design of the game,

which are: attention focus, competence, and motivation, and these factors were evaluated through six questions that were asked to the participants, and in general the participants showed great interest in the game and described it as an enjoyable experience despite the fact that the participants suffer from movement problems, and it showed Tests the feasibility of using gesture-based games in treating stroke patients.

The study of (Fang et al, 2015) designed an interactive game based on movement exercises called (Fitness Program) (EFS), which was specifically designed by healthcare experts to increase body strength in the elderly, and body gestures and movements were identified using Kinect, Body movements were required as part of the game exercises, and after the experiment, the participants answered the PARQ questionnaire, which measures the degree of pleasure in performing physical activity. This study showed that game-based exercises won the participants' approval and the described it as a positive experience.

The study of (Sheu et al, 2015) aimed to address the problems associated with designing a gesture-based system that allows the elderly to play in a safe, comfortable and fun way. This study used two gesture-based games, and the evaluation was done in three stages as follows: (1) a pre-questionnaire To collect basic information about the participants; (2) Show game method, sign consent form, use and test the game; (3) Post questionnaire and interviews, the study showed that the difference in gesture design affects usability.

After reviewing and analyzing the previous studies, it was found that some of them used the Kinect device to interact, and some of them used the Wii device, this observation makes us bear in mind that the sensor used in the interaction may positively or negatively effect on the usability assessment, so this research used the Kinect device due to its popularity and increasing use with games which does not require a controller. Given these studies of

the usability of gesture-based games, there was no unified measure of usability due to the difference in dependent and extraneous variables in those studies, in addition to the researchers using different tools to evaluate gesture-based interfaces. And that the studies were applied to the elderly in the tasks of health rehabilitation, and some of them were conducted on the youth, but there is no study conducted on children or the learners at the school stage. And that the gesture-based games that were applied in these studies were not educational games but rather recreational and sports games, that is, there is a need to create evaluation scales according to the age and characteristics of the user and take into account the difference in the level of effort required to perform the tasks during the interaction and take into account the sufficient time to do the tasks, and take into account, The goals of the system, which was designed to achieve it, whether they were educational, recreational or health goals, all of that encouraged the preparation of a scale to assess the usability of gesture-based educational games, specifically for primary school children.

Research procedures:

- 1) Conducting a survey of references and previous studies related to the research topic and its variables; In order to prepare the theoretical framework for the research, which is related to the following topics: Educational games based on gestures, and usability.
- 2) Determine the gestures based electronic educational games for the current research and evaluate them in the light of the design criteria by presenting them to a group of experts and referees specialized in the field of educational technology, to see the extent of their conformity with the standards of educational design.
- 3) Preparing the teacher's guide for using electronic educational games based on gestures, presenting it to a group of experts and referees specialized in the field of educational technology, and

making the necessary adjustments.

4) Preparing the usability scale in its initial form and presenting it to a group of experts and referees specialized in the field of educational technology to ensure its suitability for application, and to make the necessary adjustments.

5) Conducting an exploratory experiment to amend the research tool (the usability scale), to know the suitability of the experimental treatment material, determine the time plan for the basic experiment, and limit the problems or difficulties that may arise during the implementation of the basic experiment.

6) Conducting the basic research experiment according to the following steps:

- The place of implementation of the experiment was prepared in the classroom at primary language school, where the availability of a Data Show device and a display screen was confirmed, and the two researchers used their laptop as well as they bought the Kinect sensor from an internet site, and downloaded the ready-made educational games based on gestures from the internet for free.

- Selection of a voluntary random sample of third-grade primary pupils from the Primary Language School in Mina Center - Mina Governorate for the academic year 2019/2020.

-The researchers met with the students of the basic experiment sample before implementing the experiment and explained to them the goal of the experiment, as well as the goal of the electronic educational games based on gestures, and they explained to them how to use the games, as well as how to interact with the main interface of the games, instructions, the content of the games, and how to stand before Kinect sensor correctly

- The basic search experiment was implemented in the period from Wednesday corresponding to (12/2 / 2020) to Wednesday corresponding to (3/4/2020).

-The teacher's guide, which was prepared in advance, was used

because it contain to the plan of distributing games to classes and topics to be learned, as the number of classes reached 8 classes distributed over four weeks with two periods for each lesson, starting in ascending order, then number and pronunciation, then addition and subtraction, then multiplication and division. The pupils were prepared to learn cooperatively by dividing the pupils into groups, each group consisting of only two pupils, and the blended learning strategy was relied on.

- Applying the measuring tool (Usability Scale) to the research sample.

7) Obtaining data and processing it statistically to test the validity of the hypotheses and arrive at, discuss and interpret results.

8) Provide recommendations and proposed research in light of the results of the results.

Building the Usability Scale:

The current research aims to reveal the effect of gestures based educational games on the usability at primary school pupils, it was therefore necessary to prepare the usability scale; the scale was prepared according to the following steps:

1- Determining the sources for deriving the scale: A review of some Arab and foreign literature, studies and research that dealt with measures of usability and usability of gesture-based educational games, results and recommendations of previous research and studies, and related conferences, which were presented in the theoretical framework.

2- Initial picture of the gesture-based educational toys usability scale: The usability scale of gesture-based educational games was prepared, as the scale included in the initial form on (7) dimensions: the purpose of the games, impression and ease of use, content, links, navigation and interaction, visual design, and the need for educational games based on gestures, and included In the same order, examinational items (1, 9, 6, 2, 10, 3, 5), and it was

defined five levels to assess the ability to use educational games based on gestures from the student's point of view for all areas of the scale according to the following gradation: Strongly Agree, Agree, Not Sure, Not Agree, Strongly Not Agree.

3- Validity of the scale: To verify the validity of the scale, it was presented to a group of arbitrators and experts in the field of educational technology; In order to ensure the procedural wording of the scale's vocabulary, its clarity, the ability to measure it, and its suitability for the pupils' age. The judges suggested making some amendments, as follows:

- The arbitrators agreed that the quantification of the scale should consist of three levels (agree, uncertain, and disagree), provided that the scores are calculated according to the following order (3, 2, 1) degree for each item of the scale. If the student chooses the first choice, he gets (3) degrees, and the second choice is not sure (2) two degrees and the third choice does not agree with (1) a degree for each item of the scale.
- Amending some items of the scale.
- Deleting some items, and replacing them with other items because they do not belong to the domain.
- Delete duplicate items.
- Amending the wording of some items to suit the pupils 'age.
- Merging some similar dimensions.

4- Calculating the validity of the internal consistency of the scale: The validity of the internal consistency of the scale was calculated by applying it to a sample consisting of (12) pupils from the research community and outside the main group, the correlation coefficient was calculated between the degree of each of the scale vocabulary and the total degree of it, and the correlation coefficients ranged between the degree of each vocabulary The usability scale between (0.59: 0.88), all of which are statistically significant correlation coefficients at the level of significance (0.01), which indicates the validity of the internal consistency of

the scale.

5- Calculating the stability of scale: The coefficient of (a) "Kronbach" alpha was calculated using the statistical processors program (SPSS), and it was found that the reliability coefficient is equal to (0.83), which is a significant stability coefficient at the level (0.01), indicating that the scale has a high stability ratio, which indicates the validity of the scale for application.

6- Final image of scale: After ensuring the validity of the scale and its stability, it became composed of (6) dimensions, namely: the purpose of the games, impression and ease of use, content, navigation and interaction, visual design, and the need for educational games based on gestures, and included in order the examinational items are: (1, 3, 3, 4, 1, 4) and three levels were defined to estimate the usability from the student's point of view for all dimensions of the scale.

Research results:

According to the hypothesis of research that states:

"There is a statistically significant difference at the level of (0.05) between the calculated average of the research sample in the scores of the usability scale and the level (90%) of the total score of the scale in favor of the research group."

The hypothesis was validated by using the (one simple T-test) to calculate the significance of the differences between the average scores of the research group and the level (90%) of the total score in the post measurement of the usability scale, and the results shown in the following table were reached:

Table (1) the significance of the differences between the average

calculated for the research sample in the scores of the usability scale and the level (90%) of the total score (the maximum score = 48), (n = 30)

Group	The Average	Standard Deviation	Degree of Freedom	"T" Value	Level of Significance	Type of Significance	ETA Square	Effect size
Post application	47.13	1.50	29	14.33	0.01	significant	0.87	big
The level of usability	43.2	0.00						

It is evident from the previous table that the average scores of the research group in the post application of the usability measure is (47.13) while the level is 90% of the total score for the usability scale (43.2). It is noticed here that the average of the group has reached and exceeded the degree of ability For use, the value of (t) equal to (14.33) at degrees of freedom (29) has significance (0.01), and since this significance is less than the level of (0.05), so there is a significant difference between the calculated average of the research sample in the scores of the usability scale and the level (90%) of the total score in favor of the research group, and on this basis the research hypothesis was accepted in terms of the presence of difference and direction together.

Interpretation of the results:

Through research hypotheses and from the reality of the data that have been reached and that have been statistically processed, it has been interpreted and discussed based on personal vision, experimental treatment material, previous studies and learning theories. The results concluded that educational gesture-based games contributed to an increase in the usability at primary school pupils. These results are due to several reasons, the most important of which are:

1) The efficiency and usability of electronic educational games based on the gestures proposed in the current research, in terms of ease of use, good design in accordance with standards, accuracy of information, simplicity in design, legibility and flexibility in control.

2) The educational games based on gestures suggested in the current research depend on the movements of the whole body (hand movement, arm movement, foot, jumping, and sitting), and each game has different gestures related to the design and rules of the game, this is in line with the embodied perception theory that believes that connecting Cognitive tasks with the physical environment can support the understanding of the concept and the learning processes of students, and that involving the human body in learning with the aim of remembering information illustrates how embodiment can affect memory by realizing that the mind and body together shape the individual's experiences and experiences, so the learner learns better through experience and what It performs its own action and work, and the activities that depend on the physical aspect and thus support the motor learning style.

3) The electronic educational games based on the gestures proposed in the current research provide a variety of methods of reinforcement and feedback through the diversity of games in terms of design and rules, thus changing the feedback and reinforcement in each game and the correlation of reinforcement with the type of gestures that the student makes it was help to increase the ability of students to learn This caused them to advance in response, performance that leads to positive reinforcement, turn away from response and performance that leads to negative reinforcement.

4) These results are consistent with the results of previous studies that were mentioned in the theoretical framework of the research, the most important of which are: (Fang, et al, 2015; Sheu, et al,

2015; Liu, et al, 2014; Shin, et al, 2014; Francese, et al, 2012).

Research recommendations:

In light of the findings of the research, the researchers recommend the following:

1. Attention to increasing the trend towards the use of electronic educational games based on gestures in the educational process because of their good effect on the usability of elementary school students.
2. Converting the activities of the textbook into electronic learning games based on gestures and integrating them with the curricula that students study in the school, research that becomes an integral part of the curriculum, especially for elementary school students.
3. Attention to measuring students' ability to use gesture-based learning environments.
4. Work on developing the infrastructure in schools by using modern technical devices such as motion sensors.

Suggested research:

In light of the results of the current research, the following studies and research can be proposed:

1. Conducting research comparing the gesture-based electronic educational games with the regular electronic educational games.
2. Conducting research that shows the effect of the use of electronic educational games based on gestures in developing the cognitive aspects of primary school pupils.
3. Study the effect of usability of gesture-based learning environments on learning mastery.
4. Study the different design of gestures in electronic learning environments and their impact on different learning outcomes.
5. Study the different learning styles (kinesthetic with gestures, visual, and auditory) in electronic learning environments and their impact on learning outcomes.

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