The Effectiveness of QR code Technology in Developing Digital Game Programming Skills in the Programming Curriculum and Motivation Towards Digital Transformation Among Fifth Grade Students

فاعلية تقنية رمز الاستجابة السريع "QR code" في تنمية مهارات برمجة الألعاب الرقمية في منهاج البرمجة والدافعية نحو التحول الرقمي لدى طلاب الصف الخامس الأساسي

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Abstract

The study aimed to identify the effectiveness of using QR code technology in developing digital game programming skills in the programming topic for the fifth grade as well as to identify their motivation towards digital transformation. To achieve this aim, the researchers used the quasi-experimental approach. The study sample consisted of (30) fifth grade students from Bahrain Primary School for the scholastic year 2021/2020, and the study sample was treated as one experimental group that learned by using the QR code technology. To achieve the study objectives a cognitive test to measure digital game programming skills and a motivation scale towards digital transformation. The validity and reliability of the tools were confirmed. The results showed that the QR

code technology was effective in developing digital game programming skills, that it increased the level of motivation towards digital transformation among fifth-grade students. The most important recommendations of the study are paying attention to employing modern technologies in education, and working to stimulate students' motivation towards digital transformation.

Keywords: QR code, modern technologies, digital games, motivation, digital transformation.

ملخص

هدفت الدراسة إلى التعرف على مدى فاعلية استخدام تقنية رمز الاستجابة السريع QR code في تنمية مهارات برمجة الألعاب الرقمية في مبحث البرمجة للصف الخامس الأساسي والتعرف على دافعية الطلاب نحو التحول الرقمي، وتحقيقاً لهدف الدراسة استخدم الباحثتان المنهج شبه التجريبي، وتكونت عينة الدراسة من (30) طالباً من طلاب الصف الخامس الأساسي من مدرسة البحرين الابتدائية للعام الدراسي 2020/2021، وتكونت عينة الدارسة من مجموعة تجريبية واحدة تعلمت باستخدام تقنية رمز الاستجابة السريعة QR code، وتم إعداد مجموعة من الأدوات لتحقيق أهداف الدراسة وهي الاختبار المعرفي لقياس مهارات برمجة الألعاب الرقمية ومقياس الدافعية نحو التحول الرقمي وتم التأكد من صدقها وثباتها. وتوصلت نتائج الدراسة الى فاعلية تقنية رمز الاستجابة السريع QR code في تنمية مهارات برمجة الألعاب الرقمية، وزيادة مستوى الدافعية نحو التحول الرقمي لدى طلبة الصف الخامس في مادة التكنولوجيا. وخلصت الباحثتان إلى مجموعة من التوصيات من أهمها: الاهتمام بتوظيف التقنيات الحديثة في التعليم، والعمل على تحفيز دافعية الطلبة نحو التحول الرقمي.

الكلمات المفتاحية: رمز الاستجابة السريع QR code، التقنيات الحديثة، الألعاب الرقمية، الدافعية، التحول الرقمي.

Introduction

It is no longer strange in the third millennium and in the age of digitization to talk about the intrusion of technology into all sectors of life, especially the education sector. Where e-learning has become essential to ensure the continuity of the educational process, and the need has become urgent to employ its techniques as well as to develop new technologies to be added to the available educational technology tools . Specially in the digital transformation taking place in the world due to the Corona crisis

that imposed itself and contributed greatly to accelerating the digital transformation in education. E-learning has become a mandatory path in schools and universities, so there was a need to devise modern educational strategies and techniques capable of keeping pace with the times and promoting distance education. One of these technologies is the Quick Response Code (QR code), as it is among the modern technologies that were initially designed for commercial purposes and then quickly moved to the field of education, especially after the widespread use of smart phone devices in education before that. It was known as "mobile learning", which provided an opportunity to employ QR code technology in education on a large scale.

Atta (2017, 287) states that "The use of the QR code in educational situations may lead to differentiated instruction, by directing the appropriate support to some outstanding students and sometimes stumbling students through some audio or visual sources. Instead of waiting some students to ask teachers to help them complete some aspects or inquire about some ambiguous points they have, the QR code is one of the quick solutions to these situations and more effectively, away from the severity of the anxiety that some students face when asking teachers".

According to (Županović, & Tijan, 2012) QR code is a reliable educational tool as it ensures safe and easy access to educational content, allows learners to learn inside and outside the classroom, provides an opportunity to engage them in educational activities and increase their interaction. Moreover, it helps to organize and speed up access to educational materials. Additionally, QR code is a technology that can be used through the smartphone as it is inexpensive, suitable for all ages, specializations and early educational stages. Also, it helps students to manage their time and to prioritize their educational tasks.

This technique had increasing interest in recent research and studies, such as the study of Mahmoud& Hariri (2020), which aimed to identify the use of an educational booklet supported by a QR code. Additionally, identifying its impact on some learning outcomes in ballet for students of the second year for girls at the Faculty of Physical Education, Sadat City

University. The study recommended of the importance of using a QR code in the educational process.

While the study of Durak, *et al.* (2016) focused on addressing the positive effects and the learner's response to the use of QR code technology in education, as this study aimed to re-design a unit of university courses supported by QR code. And the study concluded that enjoyable learning environments supported by QR code technology increase students' motivation towards learning, because it provides the advantages of visual elements, attractiveness and direct guidance.

As it was added by the study of Mehendale, *et al*. (2017) that it is possible to convert educational materials that may be in the form of text, a website, a URL, a YouTube video, a PDF file or an image file to a QR code. This QR code can be easy handled through a smartphone, which can be an effective teaching method, and the results showed that the use of a QR code in learning enhances learners' motivation, communication, cooperation and critical thinking.

The study of Ismail and Al-Watedi (2020) confirmed the need of having several designs of the QR code in educational curricula to attract the attention of learners and provide educational content faster and easier. As well as training teachers to produce the QR code by themselves and use it in the educational process.

The study of Lai, *et al*. (2013), emphasized that the employing of QR code to enrich the curriculum and provide external activities helped to achieve better learning outcomes for primary students. Also, this was confirmed by the study of Farhoud & Ibrahim (2016), that its results concluded of the effectiveness of using the QR code in developing students' knowledge sources analysis skills.

It is clear from the previous studies and their results that employing of the QR code in education is considered one of the educational stimuli that related with distance education. And the two researchers summarized the advantages of employing in education for the teacher and student in the following points:

－ Quick setup and ease of design.

－ It does not require special capabilities and is not financially expensive.

－ Quick and direct access to educational content and knowledge sources.

－ Saves time and effort in accessing educational materials.

－ It is a safe mediator that transfers the student directly to the intended learning material or activities.

As mentioned by Orabi (2014), programming is one of the most important means that supports the children's learning of basic skills, such as problem-solving and logical thinking skills. However, the difficulties experienced by programming languages in general are considered as an obstacle to programming at lower levels; therefore, it was difficult to benefit from them. But with the emergence of simple programming languages as Scratch and Minecraft, they have been able to remove the barriers between learners and programming concepts, by transcending the complexities of programming and replacing them with programming objects and sections that open the doors of creativity for learners from the widest and most enjoyable ways.

The study of Abdul-Halim & Al-Iraqi (2021) aimed to determine the appropriate programming skills for gifted kindergarten children to learning programming skills. And the results of the study showed the effectiveness of the Scratch program in teaching programming and developing the habits of mind of gifted kindergarten children. The gifted kindergarten children were greatly affected by the program.

The study of Kaplan, *et al*. (2020) aimed to develop methodological approaches for programming primary information in primary school by using the Kodu Game Lab environment. The researchers took into account a variety of trends in primary education programming in addition to the relationship between learning programming with the development of computational thinking. The researchers identified seven systematic aspects of using the Kodu Game Lab and provided examples of their implementation. The study found that the Kodu Game Lab had succeeded

in developing students' thinking, raising awareness and progressing in reading and writing.

Gerges' study (2017) aimed to develop some performance skills and technological thinking among first year middle school students by studying the Scratch programming language unit by using the participatory learning style that is based on e-learning, and the results of the research found a statistically significant difference at the level (0.01) between the mean scores of the students of the control and experimental groups in the post application of the achievement test and the observation card for the performance skills of the Scratch programming language in favor of the experimental group. From the foregoing, we conclude that programming helps students with informational fluency and the development of dealing with new digital technologies in addition to developing many skills such as the skill of producing and programming digital games.

According to Al-Hilah (2007), educational technology has concerned with digital game strategies, and it has been launched in the educational process under the slogan (Learn and Enjoy) in which the learner combines playing and learning at the same time. The digital games contribute to supporting learners with twenty-first century skills and motivating them towards learning. Besides that, the educational games are among the active interactive technologies which can be employed in education to engage learners. It is also considered one of the digital learning strategies that seek to develop the learner's preparations and to achieve educational goals. The importance of the role of educational games in education is due to being an essential entrance to the growth of learners from the mental, physical, social, moral and emotional aspects in getting rid of tension.

Hijab, *et al*. (172: 2015) defined digital games as "an educational tool that mixes between learning and entertainment by providing educational content with specific educational goals in a competitive and enjoyable framework. All of which gives him the freedom to explore and experiment effectively within the electronic educational environment to develop concepts and cognitive skills".

Abu Jarbou (2018) and Jaber (2020) presented the importance of using educational electronic games in distance education in stimulating focus and attention of the learner. Moreover, it provokes contemplation and thinking, improves academic achievement, encourages the transfer and dissemination of knowledge among learners and increases their desire to obtain information. Electronic games are considered a powerful educational tool; it creates an integrated learning environment that focuses on the learner and develops his cognitive skills.

Several studies indicated the importance and effectiveness of digital learning games in developing many skills, such as the study of Saleh & Hassan (2018), which concluded that there are statistically significant differences between the average scores of students' motivation in the control group. In favor of the experimental group that used educational games in skills. The study recommended the need of using new methods and strategies in education that make the student an active participant in the educational process.

While the study of Abdel-Moneim, *et al*. (2020) confirmed the effectiveness and efficiency of the learning strategy by digital projects in developing the skills of designing educational games for the students of the Faculty of Education at Al-Aqsa University in Gaza. The study of Taha et al. (2020), indicated the effect of digital stimuli in developing the skills of producing electronic educational games, and engaging in learning for the students of a sample.

Bayoumi's study (2019) revealed the interaction between the content presentation style (total / analytical) and learning style (extroverted / introverted) in an augmented reality environment that is based on motivational games, all of which aims to develop academic achievement, social communication skills and motivation among educational technology students. The results concluded that there are Statistically significant differences at the level of significance (0.05) between the mean scores of the research sample students in the "Computer Mathematics" course in the cognitive achievement test, social communication skills and motivation. This is due to the different style of the presentation of information (total/ analytical) in favor of the group that studied using the analytical

information display style in a motivational game-based Augmented Reality environment.

Saleem's study (2020) recommended of the necessity of employing game stimuli in the e-learning environment. This is to develop the knowledge and skills of middle school students help in increasing learning motivation, and to train teachers on methods of using and developing them within educational materials.

With the increasing use of technology in our lives, there is an increasing need to adapt digital technologies in the educational ecosystem. Thus, digital transformation has become an urgent necessity that imposed by the rapid development in the means, tools and applications of various educational technology. This was confirmed by Allam (2020) study that the digital transformation of the teacher and the learner is a necessary requirement and one of the most important educational competencies at the present time.

Digital transformation in education is concerned with practicing the teaching process by creating electronic classes equipped with technical teaching aids, and providing several types of technology-based learning in the modern concept such as distance learning. This was confirmed by the Zeghdoud study (2020), which revealed the impact of digital transformation on the development of the concept of e-learning, and its practices. It has become a real and indispensable alternative to traditional education, and to make a real change in all aspects of the educational process.

The digital transformation in e-learning aims to raise the level of performance of educational and administrative tasks without any error and to provide a set of benefits and electronic services to the parties of the educational process. Additionally, to improving educational outcomes, achieving the required results, keeping pace with modern technical developments around us and innovating new ways to solve the problems and strive for creativity, excellence and competition. (Ed Clark, 2018)

Several recent studies and research have shown the importance of digital transformation and called for the need to move towards digital

transformation instead of traditional environments in the educational process. Because it has a good impact on students' achievement, skill performance and creative thinking, such as the studies of Ibrahim & Mohamed study (2021), and Ismail study (2020). These studies revealed the effectiveness of an electronic program to develop digital transformation during the management of the "Covid 19" educational crisis for the students of the Faculty of Physical Education. The study recommended the necessity of digital transformation and urged the Ministry of Education to implement the digital learning in line with the technological age and the needs of the labor market.

Mohammad (2021) studied the effectiveness of e-learning in developing the skill performance of students of the Faculty of Education at the University of Tobruk during the spread of the "Covid 19" virus. This study found that there is a statistically significant difference at the level (0.05) between the average scores of students in the experimental group in the Pre and post implementation for the note card which came in favor of the post implementation.

The results of Al-Mutairi study (2021) indicated to the effectiveness of e-learning during "Covid 19" pandemic from the point of view of secondary school students in the Farwaniya region in the State of Kuwait. The study recommended to provide suitable educational environment for the implementation of the e-learning and to remove all the humanitarian and technical obstacles and to work on integrating the face-to-face education and e- learning in order to benefit from the advantages of e-learning.

It is clear from the above the positive of digital transformation and the effectiveness of its various techniques in overcoming the Corona crisis. The two researchers believe that this transformation must be accompanied by the development of all digital learning inputs from teachers, learners, tools and devices to ensure the success of the transformation process to the digital education. Moreover, developing students' motivation towards digital transformation in order to reach the desired goals of this transformation.

Motivation: is considered as one of the most important prerequisites for learning, especially during the trend to e-learning. With the availability of tablets and mobile phones to the students, it has become necessary to use available mobile applications in developing students' motivation towards learning, and this what was confirmed by Salem (2020). In his study, which recommended the need to use mobile applications while teaching chemistry in Saudi schools in order to improve students' motivation towards learning chemistry.

Motivation is one of the strongest reasons for learning as the motivation to learn is the force behind the learner's behavior and works to motivate him and sharpen his energies towards practicing the necessary aspects of activity according to different educational situations. And it urges the learner to acquire more experiences, knowledge and skills in order to ensure the achievement of the desired goals. It is also a tool that may compensate for some weaknesses in his ability to learn (Helmy, 2018).

Hartnett, *et al.* (2011) argues that motivation can affect what we learn, how we learn and when we choose to learn. As it is the process directed towards motivating the learner and increasing his activity. Ramoud (2017), has quoted from Belenky & Nokes-Malach (2012), that the motivation is a set of internal and external circumstances that move learners to achieve their needs and rebalance them. Thus, it has three basic functions in behavior: stimulating, directing and maintaining its sustainability until the satisfaction of their needs.

Among the studies that emphasized the importance of students' motivation towards e-learning is the Ramoud study (2017), which studied the impact of the interaction between the "individual participatory" personal e-learning environment and the "independent, accredited" cognitive style, as well as its impact on developing cognitive achievement and motivation towards e-learning for the students of the educational diploma. All of which showed that there is a statistically significant effect of the interaction between the personal e-learning environment style and the cognitive style in developing motivation towards e-learning.

The study of Al-Abadi (2020) aimed to identify the effectiveness of using the Kahoot application in increasing motivation and academic achievement for the eighth-grade students in history course. The study of Al-Zayd (2019) pointed to a very important topic, which is the relationship between the application of electronic assessment programs (Kahoot) as a model and the increasing of the students' motivation towards learning.

The study (2011) Hartnett, *et al*. aimed to examine the motivation towards online distance learning environments. The results of this study have shown that motivation is complex, multifaceted and depends on the situation. And it cannot be fully explained from the perspective of motivation either as a learner characteristic or an effect of learning environment design, which effects on the teachers.

It is concluded from the above that the motivation towards digital transformation refers to motivating the learner to learn and excel in the use of e-learning innovations and technologies and their employment in the educational process. An example is employing QR code technology to reach the highest level of learning to achieve success.

This study aimed to identify the effectiveness of the QR code, which is one of the newly used technologies in the educational field in developing digital game programming skills and motivation towards digital transformation for the school students.

The Problem of Study

The authors and computer tutors noted the difficulty of students comprehending digital game abilities and the problem of accessing the links that explain these skills. An exploratory study was conducted to diagnose this issue, which revealed that students require more convenient approaches to use in their education, such as utilizing modern technologies in education like QR code technology.

Taking into consideration the aforementioned, the authors were able to pinpoint the issue of the current study, which can be specified in the following main question:

What is the effectiveness of QR code technology in developing digital game programming skills in the programming curriculum and the motivation towards digital transformation for the fifth-grade students?

The following sub-questions are derived from the main question:

1. What are the digital game programming skills that need to be developed for the fifth-grade students?

2. What are the criteria for the motivation towards digital transformation that needs to be developed among the fifth-grade students?

3. What is the effectiveness of QR code technology in developing digital game programming skills for fifth grade students?

4. What is the effectiveness of QR code technology in developing motivation towards digital learning for the fifth-grade students?

Objectives of the study

The study aims to achieve the following objectives:

– Identifying the digital game programming skills that need to be developed for the fifth-grade students.

– Assessing the effectiveness of QR code technology in developing digital game programming skills for the fifth-grade students.

– Assessing the effectiveness of QR code technology in developing the motivation towards digital learning for fifth grade students.

Significance of the study

Theoretical importance:

– Providing a list of digital games that need to be developed for fifth grade students.

– Providing a list of motivation criteria for the digital transformation.

– Practical importance:

– Highlighting the most important digital game programming skills and how to develop them for students.

– Contributing on helping those interested in developing programming curricula for the early stages.

– Training computer and programming tutors to use modern technologies in education.

– Assisting tutors in the educational process and providing support to scientific authors in the development of research tools.

– Education is a sector that is constantly evolving due to digital transformation. To stay ahead of the curve, modern and innovative learning methods must be adopted.

The Scope and Limitation of the Study

– The current research was limited to the limits that stemming from the research problem, which control the accuracy of the results.

– The current research was applied during the first semester of the academic year 2020-2021 on the fifth-grade students at an UNRWA school (Al Bahrain Primary School for Boys).

– The research tools were prepared by the two researchers, so the results of the research are related to their validity and reliability.

– QR codes were designed by the two researchers.

Study hypotheses

1. The mean scores of the pre-implementation did not differ significantly from the mean of the post-application on the scale of the cognitive test on digital game programming skills.

2. The mean scores of the pre-implementation did not differ significantly from the mean of the post-application on the scale of motivation towards digital learning.

The Definition of the Key Terms

QR code

Alarougi (16:2021) defines it as: "A two-dimensional code, which can be read by a QR code reader or by a mobile phone camera, that reduces the

digital data and encoding it on the form of digitally arranged points or lines."

In this research, QR code technology is defined procedurally as: a technique through which you can store a huge amount of information, numbers and letters in the form of a square-shaped symbol. And it can be read through the scanning process by using a smartphone camera via the barcode reader application.

Digital games

Abbas (2013) defined digital games as: "a set of different media (such as sound, image, movement, and text) that are combined with each other in a harmonious manner that achieves the challenge, competition and curiosity of the child in an attractive way in order to reach a game with a specific goal."

The authors define the digital game programming as: the skills of games that are programmed and designed by specialists to achieve educational or entertainment goals. Their operation depends on the availability of smart devices and allow players to compete and interact on a set of activities organized according to specific rules and score points through several levels, including individual, bilateral and group games.

Digital transformation

Al-Aloul (4:2021) defines it as "The process of getting rid of the traditional methods of the teaching process and using the latest images and means which started with the development of technology. And it can help in opening students' horizons of thinking and submit to learning and experience after he was receiving his lessons from the teacher and completely dependent on him. The method of teaching was depending on indoctrination while via digital transformation it depends on understanding, research, experiment and innovation. This is in accordance with a specific strategy set by the educational institution to facilitate the education process and at the same time reach an advanced and modern level that is completely different from the old traditional methods of education".

Operationally it is defined as: the process of replacing the old traditional methods and tools in the teaching process with technological innovations (technical and software). It is a process that requires digital competence in the use and employment of digital tools to improve the e-learning experience for students.

Motivation towards digital transformation

Ramoud (26:2017) defines motivation towards e-learning as: "a subjective desire that directs the learner's behavior towards excellence in the use and the implementation of the latest e-learning technologies the educational process, perseverance and uniqueness in performing the skill and mastering it, and exerting maximum effort to reach the highest level and achieve the greatest level." of success"

It is procedurally defined as: a state of internal arousal that motivates the learner to invest all technologies and digital innovations and all of what the technology provides in terms of tools and software. Then, employing them in order to achieve certain goals.

Programming curricula

It means the scientific and programming material included in the programming book for the fifth grade approved by the Palestinian Ministry of Education in the year 2018/2019.

Fifth grade students: Students enrolled in the fifth grade of the basic stage, whose ages range from (10-9) years.

Method and Procedure

The approaches of the study

This is semi-experimental designed to explore the impact of QR code technology based on distance learning on developing digital gaming skills and the motivation towards digital transformation of the fifth-grade students. Thus, the study variables are determined by the independent variable, which is the QR code technology based on distance learning. And it is determined by the dependent variables, which are the students'

performance on the cognitive test of digital game skills and the scale of motivation towards digital learning.

Research population: The study sample consisted of fifth grade students from all the governorates of the country, as they are studying the Palestinian programming curriculum.

The study samples

The researchers selected a (30) students from the fifth grade who are enrolled in Bahrain Primary School (A) for the first semester of scholastic year 2020-2021. That was due to the presence of a specialized, cooperative and competent teacher who was able to implement the study. The school contains six classes for the fifth grade, and (30) students were selected by the non-probability sampling as an experimental group of students who expressed their desire to learn through QR code technology.

Study tool

1. Digital gaming skills test

After reviewing the fifth-grade programming curriculum, a digital game programming skills test was prepared with five main skills, these skills are downloading the Minecraft Program, reaching the sheep, cracking firewood, cutting sheep's wool and building the home.

The initial form of the test consisted of (23) multiple-choice questions and were distributed over five main skills.

To ensure test validity, a group of experts were consulted to evaluate the scientific and linguistic accuracy of the paragraphs, as well as their relevance to the skills of the Minecraft game and their appropriateness for fifth grade students. Some questions were modified according to experts' recommendations, the overall number of questions was (23) distributed over five skills. Additionally, test initial image was assessed by a survey sample of (15) fifth grade students outside the sample.

Construct validity, internal consistency was examined by finding the correlation coefficient between the results of every test question. and the whole test. The correlation coefficient between each of the five skills and

the whole test was examined. For one question correlation coefficient was less than (0.32), so this question was deleted. As a result, the correlation coefficients between the skills after the adjustment were (0.40-0.93).

The exploratory sample was used to calculate the difficulty index and discrimination coefficients for the test items. Through this evaluation, two items were discarded from the test due to their complexity. The difficulty index of the test items after adjustment ranged from (0.65 - 0.30), and the discrimination coefficients were found to be between (0.80 - 0.65). These results are considered to be within acceptable ranges for educational contexts.

To test reliability coefficient, Kuder-Richardson Formula 20 was used, the total test was equal to (0.82), and the stability coefficients for the main skills of the test were (0.80), (0.81), (0.78), (0.84), (0.76), respectively, and all of them were statistically significant at the level of significance (0.05), which indicates to the availability of the reliability condition for the test.

To estimate test scores, one point was assigned to each question, and thus the total cognitive test scores were (20) scores.

The final version was performed after completing the modification procedures, the test was formulated in its final form. The number of its questions was (20) questions one score for each question.

Table (1): shows the specifications of the cognitive test for digital gaming skills.

No.	Digital gaming skills	learning levels				Total Questions	%
		Reme-mber	Underst-anding	Application	Higher Skills		
		number of questions					
1	Download Minecraft	3	-	-	-	3	%15
2	Getting to the sheep -	-	1	4	1	6	%30
3	Cracking wood 5	1	1	2	1	5	%25
4	Cut lamb's wool	1	-	1	1	3	%15
5	Building a house	-	1	1	1	3	%15
Total Summation						20	%100

2. Motivation Scale for Digital Transformation:

1. Preparing a table of specifications which includes the levels of motivation towards the digital transformation of the scale Table (2).

Table (2): Motivation Scale Specifications Table for Digital Transformation.

#	Fields	Items	Total	%
1	Positive trends towards digital transformation	1-8	8	%34.7
2	Enjoying distance learning	9-13	5	%21.7
3	Tendency to succeed	14-17	4	%17.4
4	Perseverance and seriousness	18-23	6	%26.1
			23	**%100**

2. Building the scale items by reviewing the educational literature and previous studies such as the study: Alamro, & Algziwaat (2021); Saghour (2020), and Ben Shawader (2021), the researchers built the motivation scale.

3. The digital transformation motivation scale was built and the scale consisted of (23) items distributed on four main axes, which are as it shown in the previous specification table (2).

4. Grades assessment: Students were rated (23) items on their agreement with each statement by using a triple scale consisting of 3 points (3 large, 2 medium, 1 nonexistent). The criterion of grade assessment expressed by students was based on their motivation towards digital transformation as follows (3-2.4 is large, 2.3-1.74 is medium, 1.73-1.07 is weak).

5. The Electronic scale was designed and disseminated electronically by using Google Forms in order to facilitate the dissemination and sharing of the link for students.

6. Constructive evaluation of the scale was examined by implementing the scale on a pilot sample (15) students to ensure the clarity of the

scale's statements and instructions. Some modifications were done to insure more appropriateness and clarity of scale.

7. The validity of the scale was verified by using apparent validity by presenting the scale in its initial form to a group of arbitrators in the field, and the observations by the arbitrators were taken into consideration. Internal construction was calculated by Pearson correlation coefficient between each degree of the scale axes and the total score of the scale. It ranged between (0.59-0.70), which indicates the internal homogeneity of the scale items.

8. The reliability coefficient was calculated using Cronbach's alpha. It was equal to (0.859), which indicates that the scale has a high degree of reliability.

9. After the above-mentioned procedures, the final version of the scale was formulated in its final form which included (23) items (table 3).

Table (3): Final form of the motivation scale for digital transformation.

Domain	Scales	
positive attitude toward digital transformation	1	e- learning motivate me to learn
	2	educational videos become more easy to understand
	3	distance learning more interesting than classroom learning
	4	I participate in all digital activities
	5	I follow online lessons on time
	6	I would like to continue e-learning after the Corona crisis is over
	7	E-learning helps me to reach learning anytime
	8	I can communicate with my teachers easily

Domain		Scales
distance learning Enjoyment	9	learning new information through the Internet is enjoyable
	10	I enjoy Performing digital assignments
	11	I can perform more scientific activities by using a computer
	12	I feel more able to be creative in e-learning
	13	I can reach digital links easily
The tendency to succeed	14	learning new information through the Internet is enjoyable
	15	I enjoy Performing digital assignments
	16	I can perform more scientific activities by using a computer
	17	I feel more able to be creative in e-learning
perseverance and seriousness	18	I retry to complete my e learning tasks
	19	Do more efforts to get better learning through e-learning
	20	review my e-lessons continuously
	21	I have the ability to succeed in studying through e-learning
	22	I am trying to get new information from the internet
	23	do my homework by myself

The study results

To answer the study question" What is the effectiveness of QR code technology in developing digital game programming skills for fifth grade students?"

The first hypothesis "The mean scores of the pre-implementation did not differ significantly from the mean of the post-application on the scale of the cognitive test on digital game programming skills" was examined. The (t) test was used to find out the significance of the differences between the mean scores of the experimental group in the two implementations, (the pre and post). Table (4) shows the results of this test.

Table (4): Results of differences between pre- & post-tests and effect size.

Test	Application	n	mean scores	SD	t value	DF	p	d	value η2	effect size
The overall score of the test	pre	30	12.57	2.83675	12.18	29	0.000	4.52	0.84	high
	post	30	19.06	.73968						

Table (4) reveals a statistically significant difference between the mean scores of the experimental group in the pre and post implementation of the cognitive test in favor of the post application. This is the highest average and equal to (19.06) where the value of (t) was equal to (12.18), which is statistically significant at the level (0. 01). This result rejects the null hypothesis, demonstrating the extent to which students improved in their cognitive test scores as a result of studying programming skills via the QR Code technology. This outcome is attributed to the students' easier access to educational material through the use of such technology on their smart devices or tablets, making learning simpler and more enjoyable when effectively practiced and activated.

Calculating the effect size

To find out the Effect size of the QR Code on developing the skill of programming educational games, the η2 and d values used with the following estimation of the effect size: for d (high 0.8, medium 0.5, and low 0.2 or less), and for η2 (high 0.14, 0.06 medium, and 0.01 or less low).

It is clear from Table (4) that the value of eta square in the total score of the test is (0.84) which is greater than the value of eta square (0.14). This indicates to the significant effect of the independent variable. The researchers linked these results to the great motivation of the students towards the use of techniques of the distance learning, all of which makes it easier for them to access the educational content required of them, especially during the digital transformation in education during the "Covid19" pandemic.

QR Code Technology Effectiveness

The effectiveness and extent of improvement in the cognitive aspect of acquiring digital game programming skills were calculated by using Black's earn equation.

From the above, it is clear that the adjusted gain ratio for developing the cognitive aspect of digital game programming skills by using QR technology is equal to (1.2). This is the same percentage suggested by "Black" to judge the effectiveness, which is equal to (1.2). Therefore, it can be judged that the use of QR Code was effective. It has already contributed to the development of the cognitive skills of the Minecraft program. The authors attribute this to the many advantages of this technology, the most important of which is its ease of use, speed and accuracy in accessing educational content, that enables the student to easily obtain the required components of knowledge.

The results related to the fourth question "What is the effectiveness of the "QR Code" technology in developing the motivation towards digital learning for fifth grade students?"

To answer the fourth question: the second hypothesis was validated" The mean scores of the pre-implementation did not differ significantly from the mean of the post-application on the scale of motivation towards digital learning". To test the validity of this hypothesis, a (t) test was used to find out the significance of the differences between the mean scores of the experimental group in the pre and post implementation. Table (5) shows the results of this scale:

Table (5): Results of differences between pre- & post-tests and effect size.

Scale areas	application	n	mean scores	SD	t value	DF	P	d	η2	effect size
Positive attitudes towards distance learning	pre	30	2.2520	.55251	2.382	29	0.024	0.88	*0.16*	high
	post	30	2.5417	.30324						
Enjoying distance learning	pre	30	2.2267	.54007	3.877	29	0.001	1.44	0.34	high
	post	30	2.6533	.26226						
Tendency to succeed	pre	30	2.7667	.45454	2.619	29	0.014	0.97	0.19	high
	post	30	2.9917	.20218						
Perseverance and seriousness	pre	30	2.4667	.47222	3.196	29	0.003	1.19	0.26	high
	post	30	2.7444	.19930						
Total marks	pre	30	2.4270	.44484	3.716	29	0.001	1.38	0.32	high
	post	**30**	2.7328	.15236						

It is clear from Table (5) that total post - implementation mean score was (2.7328), while pre- implementations mean score was (2.4270), "t" value for the average differences between the pre and post implementation of the total degree was (3.716) and p value was (0.01), which is less than the significance limits at (0.05) in favor of the post-implementation.

The previous results show the extent of the student's positive interaction with modern technologies such as QR Code technology. This is because of the student's desire to learn more e-learning tools that enhance the distance learning process. The study of results reflects the positive response to the use of QR technology in the educational process and its effectiveness.

Calculating the effect size

In order to find out the effect of the QR Code technique on achievement, use the value of the eta square. It is clear from table (5) that the value of the eta square in the total score of the scale is (0.32), which is greater than the value of the eta square (0.14). This indicates the significant influence of the independent variable. This result agrees with the study of Saleh (2020), Mahmoud and Hariri (2020). This is due to the spread of modern learning technologies such as QR Code technology, which can be used easily through smart devices and tablets. All of which made it easier

for students to accept and use digital learning systems and tools, and their motivation towards digital transformation.

It was clear from the results that Black's adjusted gain ratio on the digital transformation motivation scale is equal to (0.64), which is less than the percentage suggested by "Black" to judge the effectiveness and equal to (1.2). Therefore, it can be judged that the use of QR Code technology was effective to a moderate degree, and this is due to the recent use of this technology in education. As this was the first experience for the fifth-grade students and the study sample had never used QR code technology in distance learning. Therefore, the result is acceptable and satisfactory.

The authors explain the previous results as follows:

– The QR code technology has the speed of its implementation and the design of its mechanisms. It does not cost time or effort, and is used as a positive reinforce for students. Because it motivates students to continuously interact and track activities, videos and special educational explanations through their personal phones. This helped in developing digital game programming skills.

– QR code technology is easy to use as only advanced smartphone cameras can access the videos explaining programming skills by reading the barcode to see the questions and activities for the skills which are needed to be learned. All of which has greatly increased the effectiveness of the technology in developing digital game programming skills.

– The QR code technology provided the student with an enrichment material by sending the educational aids through images or videos in a barcode and providing them to the students. This increased the students' motivation to use modern technologies and learn about technical innovations, that increased the degree of their motivation towards digital transformation.

– Technology in the field of education provides many options that stimulate education and review educational content. Since it is a

private lesson, which has greatly affected their motivation towards digital transformation.

– Some students face difficulty in downloading the QR code application on smart devices, and the cut off the Internet for a long time. Moreover, the lack of acceptance by some parents to the idea of e-learning, which prompted the students to digital transformation with moderate effectiveness.

Recommendations and suggestions

In light of the findings of the research, a set of suggestions and recommendations can be presented to improve the educational reality during of the digital transformation in education:

1. The necessity of making use of the QR code technology to access multiple learning resources that support student learning and increase the development of digital game programming skills.
2. Training teachers to design and use the QR code and to use it in the educational process.
3. Include curricula and textbooks for QR code designs to attract learners' attention and to deliver educational content easier and faster.
4. Include QR code in the student's enrichment materials and paper publications to facilitate access to digital educational content.
5. Supporting the idea of digital transformation for the students and parents, and to encourage them and increasing their motivation towards it.
6. Convincing students and society to abandon the idea of traditional education and move to the digital education.
7. Benefiting from the results of research and studies that examine the use of modern technologies in education in addition to the necessity of digital transformation and its modern technologies. Also, seeking to apply them in the educational field in accordance with the nature of the curricula.

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