جامعة الإمام عبدالرحمن بن فيصل
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مجلة جامعة الإمام عبدالرحمن بن فيصل للعلوم الإنسانية والتربوية

Journal of Imam Abdulrahman Bin Faisal University for Humanities and Educational Sciences

Peer-reviewed Journal دورية علمية محكمة

J IAUHES

المجلد 1 | العدد 1 | يناير - أبريل 2023
Volume 1 | Issue 1 | Jan-Apr 2023

IAUHES
مجلة جامعة الإمام عبد الرحمن بن فيصل
للعلوم الإنسانية والتربوية

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The Effectiveness of a Distance Training Program to Develop the Skills of Using the Internet of Things among Teachers

فاعلية برنامج تدريبي عن بعد لتنمية مهارات توظيف إنترنت الأشياء لدى المعلمين

Received: 20.5.2022 **Accepted: 15.12.2022** **Published: 1.1.2023**

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أستاذ مشارك، قسم تقنيات التعليم، كلية التربية، جامعة الإمام عبدالرحمن بن فيصل

Suggested Citation: Alqoot, Abdulrzak. (2023). The Effectiveness of a Distance Training Program to Develop the Skills of Using the Internet of Things among Teachers. *Journal of IAU of Humanities and Educational Sciences. 1*(1), 44- 54 .

ABSTRACT

The educational systems, with all their components, were affected by the manifestations of the Fourth Industrial Revolution with numerous innovations. The Internet of Things (IoT) is one of the significant innovations that improves the teaching and learning environment. Therefore, it is important to keep up with the digital age by shifting from traditional classrooms to electronic platforms, and developing digital curricula and creative teaching methods that focus on the learner. This study aimed to assess the effectiveness of a training program designed to increase teachers› knowledge and skills about the IoT and its applications in educational settings. The training program was delivered remotely through a virtual class via the (Blackboard) learning management system. The sample comprised 27 general education teachers who were purposefully chosen from a group of teachers enrolled at Imam Abdulrahman Bin Faisal University to study a higher diploma in (digital skills) for two semesters in the 2022 academic year. The study conducted a cognitive test on IoT-related topics and a self-assessment scale for IoT-related skills. The findings revealed that the training program designed to develop teachers› knowledge and skills about using IoT in educational work had a positive effect with a high impact. Based on these findings, the study provided a set of recommendations and suggestions for future research in this area.

Keywords: Training program, internet of things, distance training, teacher training

الملخص

تأثرت النظم التعليميّة بكلّ عناصرها بمظاهر الثّورة الصناعية الرّابعة المتعدّدة الابتكارات، ومن هذه الابتكارات المهمّة للثّورة الصناعية: إنترنت الأشياء IoT، فهو أحد الابتكارات التي أسهمت في تحسين بيئة التّعليم والتّعلم. ولغرض مواكبة العصر الرقميّ والانتقال من الفصول التّقليديّة إلى المنصّات الإلكترونيّة، والمناهج الرّقميّة، والطّرق الإبداعيّة في التّدريس والتّركيز على المتعلّم؛ تحدّد الغرض من هذا البحث في تصميم برنامج تدريبيّ لتنمية معارف المعلّمين ومهاراتهم في إنترنت الأشياء وتطبيقاتها في الأعمال التّعليميّة.

نُفِّذ البرنامج التّدريبي عن بُعد بوساطة فصل افتراضي من خلال نظام إدارة التّعلم (البلاك بورد)، على عيّنة من معلّمي التّعليم العامّ، تمّ اختيارهم قصديًّا من مجموعة المعلّمين الملتحقين بجامعة الإمام عبد الرّحمن بن فيصل IAU لدراسة دبلوم عالٍ في (المهارات الرقميّة) مدّة فصلين دراسيّين، خلال الفصل الثّاني من العام الدّراسيّ 2022، بلغ عددهم 27 معلّمًا ومعلّمة. أعدّ الباحث اختبارًا معرفيًّا في مفاهيم إنترنت الأشياء، ومقياس التّقدير الذّاتيّ في مهارات إنترنت الأشياء. كشفت النّتائج عن وجود أثر إيجابي للبرنامج التدريبي، الذي أُعدّ من أجل تنمية معارف المعلّمين ومهاراتهم، حول توظيف إنترنت الأشياء في الأعمال التّعليميّة، وفي ضوء هذه النتائج قدّمت الدّراسة مجموعة من التّوصيات والمقترحات لبحوث مستقبليّة في هذا الإطار.

الكلمات المفتاحية: برنامج تدريبي، إنترنت الأشياء، التدريب عن بُعد، تدريب المعلمين

1. Introduction

Distance education and its means have been affected by technical and technological developments. Therefore, the learner can find an opportunity for training and education at any time and any place using these technical methods (Al-Thubaiti, 2018). In-service training for the teacher is a necessary requirement at a time when successive developments are increasing. preparing the teacher and training him to acquire the basic competencies for practicing the profession of education is one of the most important pillars on which the philosophy of education. lies in (Al-Hamoud, 2021). In a related context, the educational systems, with all their elements, were affected by many influences that contributed positively or negatively to their appearance or internal operations. Among these influences are the manifestations of the Fourth Industrial Revolution, the multiple innovations, and aspects. All of its components and parts contributed to improving the teaching and learning environment (Gad, 2022). This rapid development in technology has led to a trend towards teaching and educational policies that take technology as a mainstay in the educational process and benefit from its multiple applications. This is for the purpose of keeping pace with the digital age and moving from traditional classrooms to electronic platforms, digital curricula, creative methods of teaching and focusing on the learner.

The Internet of Things (IoT) can also be invested in education and benefit from its potential to achieve the best educational methods that rely on technology. The areas that the IoT can be used are distance education and interactive learning. Education currently requires attention to employing IoT applications in educational processes. This is to provide students with knowledge and skills and enhance their ability to organize and operate knowledge and processes and infer logical and interconnected relationships using shapes, visual drawings, and pictorial symbols (Fragou & Mavroudi, 2020). The is a hot point in modern educational technology and attention must be paid to it.

2. The Problem of the Study

It is noticeable that educational systems and institutions in recent times and in light of the effects of the COVID-19 pandemic have made training and to develop professionalism for teachers with its multiple methods a high priority in the light of resorting to technical innovations for the continuation of teaching and learning processes through the employment of its multiple applications. This includes the IoT applications, the most important manifestations of them are virtual classrooms, learning management systems and other applications that contributed to the educational administrative process. Aldowah et al. (2017) indicated that through the IoT educational institutions can provide many learning experiences that lead to support learning outcomes and student performance. The purpose of using the IoT in education is to create an environment that supports the acquisition of knowledge in a new, natural, and effective way in line with learners' needs and expectations (Kiryakova et al., 2017).

Despite the great role of the IoT technology in many sectors, there is still a weakness in educational institutions' use of this technology despite its role in finding new methods for managing educational and school environments. Therefore, there is an urgent need to integrate it into planning smart educational processes to enhance access to knowledge for students quickly, easily and with high quality (El-Dahshan, 2019). This weakness may be attributed to the lack of training programs and workshops for teachers in the field of employing the IoT in the educational process, despite its importance to support and improve the educational work of the teacher and improve learning outcomes. The results of the study Gad (2022) showed that most of the faculty members had a training need on the IoT applications. In addition to the above, the researcher found, through his work as a coordinator for the higher diploma program for teachers, which is implemented at the university in which he works. Based on the notes that were sent from the faculty members participating in teaching diploma courses to the diploma program management office, the notes showed that there were training needs for teachers who study in the diploma program in a number of aspects related to the educational process. One of these aspects is the teachers' employment of the IoT applications in educational work.

In light of the foregoing review, the study problem can be identified in the following main question:

How effective is a distance training program in developing teachers' internet of things employability skills?

The following questions arise from the previous question:

- What is the instruction design of the training program designed for teachers in the field of employing the internet of things for educational work?
- What is the effect of applying a distance training program to develop the cognitive aspect of teachers in employing the internet of things in educational work?
- What is the effect of applying the distance training program to develop the practical aspect of teachers

in employing the internet of things in educational work?

3. Objectives of the Study

- Developing a visualization of the training needs gaps for teachers in the field of employing the IoT in educational work.
- Designing a training program according to the scientific design frameworks for training programs.
- Recognizing the effect of training on the cognitive and practical aspects of teachers to employ the IoT in educational work.
- Using the remote training strategy through one of the IoT applications (virtual smart classes) to implement the training program.

4. The Importance of Study

The importance of the study is evident in a number of points: The use of the IoT in education requires research and highlighting the benefit from it in the educational process. The employment of the IoT in education is one of the recent topics that have not been studied except on a very small scale (Alaklubi, 2019).

This study comes in response to the recommendations of a number of studies that recommended carrying out a study to identify the impact of training in the field of employing the IoT, such as the study of Abdel Hamid (2021) which recommended conducting research on a training program based on the IoT to develop applications for their use and direction towards them I have teachers.

The results of the study may be used to enrich the professional to develop system for teachers in terms of qualitative topics that require an increase in training.

5. Theoretical Framework

5.1. The Concept of Internet of Things

The Internet of Things is one of the advanced concepts concerned with integrating sensory and material things together (Ibrahim & Shorb, 2020). The IoT has emerged as a new term that includes the use of smart things in addition to controlling, monitoring, and identifying them through the Internet. In addition, the IoT technologies have been used to collect and use data to improve the learning experience, support learning goals, or improve school operations and environments in general (Fraguo & Mavroudi, 2020). Regarding the concept of IoT (Bajracharya et al., 2018) indicated that there is no unified agreed definition around it as the IoT covers a wide range of technologies, processes, and applications.

However, a number of definitions of the IoT were received that were consistent in content and differ among themselves according to the philosophical premises of each definition. Among them is the definition of Alaklubi (2019) who stated that the IoT is an interactive connection through the Internet with computers and smart devices with many things, making them capable of receiving and sending data. Al-Hazani (2020) defined the IoT as the new generation of the Internet that allows understanding between devices that are interconnected with each other through the Internet protocol. These devices include tools, sensors, and various artificial intelligence tools. Also, Alalouny (2022) defined the IoT as a set of smart devices and multiple sensors that are directly connected to the Internet, making it able to send data and information and interact with it by humans.

5.2. Employing the IoT in the Learning Process Justifications, Motives, and Benefits

There is no doubt that the educational system requires continuous development and improvement in all its aspects and elements by taking advantage of all the factors, influences and developments that contribute to this, and that the employment of these factors and influences has been proven to have a positive and effective return. (Al-Salmi, Abdullah & Al-Hinai, 2020) indicates that the IoT, along with artificial intelligence technologies, will contribute to preparing students for future jobs through lessons, workshops, reference materials, and personalized education. And (Ibrahim & Shorb, 2020) believed that the IoT is working to develop many educational services, including increasing levels of safety, reducing costs, and helping to provide a distinguished educational experience.

The IoT contributes to solving educational problems through the first dimensions of availability and the second of adaptation. It allows educational institutions to experiment with new adaptive teaching methods and change the way the teacher presents lessons. It also contributes to simplifying educational administrative work and creates a safe environment for both teachers and learners (Ibrahim & Shorb, 2020).

One of the benefits of employing the IoT in teaching is its role in consolidating and improving learning outcomes by providing educational experiences that are more attractive to learning and realistic (Elsaadany & Soliman, 2017). The importance of employing the IoT in education is also evident through its role in developing student service systems, enhancing learning behaviors, analyzing problems at the university level, and improving students' academic performance and its impact on teachers' teaching performance (Song-

som et al., 2019). As Patel et al. (2016) mentioned there are important characteristics of the IoT which are connectivity, semantic consistency, heterogeneity, dynamic changes, mega scale, security, connectivity, and interoperability.

5.3. Educational Applications of the IoT

There are many educational applications for the IoT in the educational system. They include smart classrooms, cloud platforms, learning management systems, adaptive learning applications, smart board applications and e-books, multimedia poster board applications and sensor applications, smart learning applications, and educational business management applications. Related to students, teachers, buildings, executive plans, emergency plans and strategic plans, individual and group interactive free learning applications, learning development monitoring applications, test management applications, information resource applications, educational content building applications (Abdel Hamid, 2021; Al-Aklabi, 2019; Gad, 2022; Alalouny, 2022). In addition to the above, there are many educational services for the IoT as mentioned by Bajracharya et al., (2018) including: providing personal and social learning environments, providing a mobile-based learning environment, providing electronic educational content via digital libraries. Mershad and Wakim (2018) indicated that one of the uses of the IoT in education is a barcode or a quick response code (QR), also from the uses of the IoT in education are radio frequency identification chips (RFID) that students use to distinguish and track physical objects for study.

5.4. The Importance of Training Teachers to Employ the IoT in Education

It has become easier in light of the development of technology to provide professional development to teachers via the network wherever they are and help them search for answers as well as learn more about the design of online communities of practice (Mohammed, 2017). Training plays an important role in developing teachers' acceptance of the IoT technology and thus to employ it in educational work, where studies indicated that there is a weakness in teachers' acceptance of this technology. IoT. The importance of teacher training to employ the IoT in education can be determined in the following points:

- Through training on employing the IoT in education, teachers will be able to effectively manage the classroom. El-Dahshan (2019) pointed out that IoT is a new way to manage classrooms using advanced tools.
- Teachers will be able to change the way they interact with students. Bajracharya et al., (2018) stated that with the help of digital technologies it is possible to change the way of interaction and improve the teaching process.
- Through training, teachers will be able to acquire a number of digital skills related to the IoT, as Gad (2022) identified a set of digital skills that the teacher must have the skill of dealing with learning management systems, the skill of dealing with digital content, managing virtual meetings, and the skill of dealing with electronic calendar methods.
- Teachers will be able to access the educational material and create educational content (Zerrougui & Valta, 2020).
- Teachers will have the ability to acquire new concepts that will make them able to manage the future and prepare to deal with it, to improve their teaching performance and to develop their ability to deal with modern technologies(Al-Kharousi et al., 2020).

6. Studies Related to the Study Topic

There are a number of studies that dealt directly and indirectly with the IoT and their relationship to the educational process. The researcher benefited from the implications of the results and recommendations of the previous studies in the context of the current study. One of the relevant studies is the study of (Kiryakova et al., 2017) showed that the IoT had the ability to change learning and teaching patterns significantly. The study also found that there were difficulties in applying the IoT in education, the most important of which is the existence of an effective infrastructure that supports knowledge in institutions educational.

The results of the study of Songsom et al., (2019) showed the importance of employing the IoT for its role in developing student services systems, promoting learning behaviors and analyzing its problems at the university level. The results of the study Lee et al. (2019) also showed a weakness in the dimensions of technological acceptance towards the IoT among university students. The results of the study of Alaklabi (2019) also showed that the IoT had an effective contribution to the development of educational institutions. The study recommended conducting more studies that deal with the relationship between the IoT services and its applications and the work of educational institutions. It also recommended raising awareness about the importance of the IoT in the development of education. The study of El-Dahshan (2019) also recommended working to increase awareness of

the role of the IoT in developing educational services through specialized workshops and seminars. While the results of the study of Abdel-Raouf (2020) found an effect of the training program on the level of acceptance of the IoT technology by student teachers in favor of dimensional measurement. It also recommended the necessity of employing IoT applications to develop design thinking among student teachers. The study of Hassaneen (2020) showed that the IoT worked on individualizing education and considered individual differences among learners and enhances the freedom of learning. The IoT is an important factor in the development of educational systems.

The results of the study of Al-Kharousi et al. (2020) also confirmed the necessity of providing student teachers with the concepts of the Fourth Industrial Revolution and enabling them to employ its technologies because of their importance in making them able to manage the future and prepare to deal with it, to improve their teaching performance and to develop their ability to deal with modern technologies. The study of Zerrougui and Valta (2020) also recommended the importance of teacher training on employing technology and smart systems to keep pace with the developments resulting from artificial intelligence and qualifying him educationally and technologically. The results of the study of Abdel Hamid (2021) showed that there was an effect of the training program through employing an educational environment based on the IoT in favor of the dimensional application. It also recommended conducting research on a training program based on IoT applications to develop their use and direction among teachers.

The results of the exploratory study conducted by Ahmed et al. (2021) on a sample of educational technology students at the College of Education showed that approximately 89% of them did not know what the IoT is. The study of Lyu and Wang (2021) concluded that teachers can develop more flexible teaching strategies and tools for accurately assessing students' performance based on the IoT theories. The results of their study also provided a theoretical contribution to the application of the IoT in the design of teaching. The study of Veiga and Andrade (2021) showed that information and communication technology had a positive impact on motivating teachers and their participation. The results of the study of Gad (2022) showed that most of the faculty members have a training need on the IoT applications.

7. The Study Method and Procedures

For the purpose of implementing the research treatment of the subject of the study problem and achieving its objectives, the descriptive-analytical approach was used in order to determine the gap in teachers' knowledge and skills about the IoT and their educational applications and to develop the educational design of the training program. The quasi-experimental approach was also used to verify the effectiveness of the application of the training program in developing the employment of the IoT and its educational applications for teachers enrolled in the higher diploma in digital skills through training them remotely through a virtual class in the learning management system available from the university.

7.1. Variables of the Study

The independent variable

The training program in the concepts and employability of skills, the IoT in education.

7.2. The Dependent Variables

(1) Developing knowledge related to the IoT and its educational applications,

(2) Developing practical skills to employ IoT applications in education.

7.3. Research Community

The research community represents male and female teachers enrolled in the Diploma of Digital Skills, which was implemented at Imam Abdul Rahman bin Faisal University (IAU) in the Kingdom of Saudi Arabia. It was conducted during the second semester of the academic year 2021/2022. They were multidisciplinary and work in the general education stages. Their educational and age characteristics vary. They were enrolled in the study because they needed a number of digital skills to improve educational work after completing their diploma.

7.4. Sample of the Study

The sample on which the research was applied represents a group of teachers enrolled in the Digital Skills Diploma, and their number was (27) teachers and teachers were chosen on purpose. Their ages range between (31-47). 67.4% of them were males, 32.6% were females. Their scientific specializations vary between social and natural sciences, languages, and Islamic sciences. They work in different stages of public education between primary, intermediate, and secondary levels.

7.5. Experimental Design of the Study

One-Group pre-posttest design was used, where the research group was selected from teachers enrolled in the Diploma in Digital Skills at Imam Abdul Rahman

bin Faisal University (IAU). The pre - posttest of the study instruments was applied to the experimental research group, and the following Table 1 shows the experimental design of the research:

Table 1

The Experimental Design of the Study

Pretest	Treatment	Post test
1. cognitive test 2. self-esteem scale of the internet of things skills	Study of the experimental group of the distance training program through the virtual classrooms of the University's Learning Management System (LMS)	1. cognitive test 2. self-esteem scale of the internet of things skills

8. Limits of the Study

8.1. Subject Limits

The current study was limited to studying the impact of a distance training program through a virtual class to develop and develop the IoT employment on teachers' educational work.

8.2. Human Limits

This study was limited to male and female teachers enrolled in the Diploma in Digital Skills implemented by Imam Abdul Rahman bin Faisal University (IAU).

8.3. Spatial Limits

It was implemented through the Learning Management System (LMS) of Imam Abdul Rahman bin Faisal University (IAU).

8.4. Time Limits

The research was conducted during the second semester of the academic year 2021/2022 AD

8.5. Instruments

For the purpose of achieving the objectives of the research, the researcher prepared two tests:

Cognitive Test in the Concepts of the IoT: The test is designed and prepared with the aim of measuring teachers' mastery of the concepts of the IoT and their applications in the educational process. The previous literature was consulted as the in the studies of (Al-Aklabi, 2019; Abdulhamid, 2021; Bajracharya et al., 2018; Fragou & Mavroudi 2020; Mershad & Wakim, 2018). The researcher benefited from them in formulating the test items in an objective way. Multiple choice, measuring cognitive aspects according to Bloom's classification of "understanding - application - analysis - structure, evaluation"; the test covered the elements of the training program's content in the concepts of the IoT and its educational applications. The test instructions were formulated in simple and clear sentences that explained how to answer his questions. The test included (40) items in its final form of the type of multiple choice. A score of "one" was assigned to the correct answer to the item, while a score of "zero" was assigned to the wrong answer, and the test was answered and corrected electronically, and the total test score consisted of (40) degrees.

The validity of the content or the structural validity of the test was confirmed. The test was validated by a panel of from faculty members in the area of education. They were requested to give their observations about the wording of the questions, linguistic integrity, the suitability of the question to the objective it measured, the questions covering all the elements of the training program, the scientific accuracy of its formulation, and the appropriateness of the number of test items. The necessary modifications were made according to their opinions. The researcher also calculated the internal validity of the test by calculating the matrix of correlation coefficients between the test phrases and the total score of the test. The values of the correlation coefficients ranged between (0.486-0.873), and they were significant values at the level (0.01) and they indicate the extent of the consistency of the internal construction of the cognitive test. The reliability of the test was calculated using the "Cronbach's alpha" reliability coefficient. The value of the reliability coefficient was equal to (0.91), which was an acceptable value for the purpose of the current research. The difficulty and discrimination coefficients were also calculated for the test items, so that four items of the test were reformulated with a coefficient of discrimination less than 0.20, and thus the test in its final form consists of (40) items valid for use for the purpose of the current research.

Self-esteem Scale of IoT Skills: The aim was to measure the self-esteem of IoT skills (performing practices) in employing the IoT in education, in three areas:

- Operational Technical Skills, which includes 10 sub-skills.
- Informational Skills, which includes 7 sub-skills.
- Communications Skills, which includes 5 sub-skills.
- The scale of the skills was built based on the previous studies (e.g., Al-Aklabi, 2019; Abdel Hamid 2021; Bajracharya et al., 2018; ; Fragou & Mavroudi, 2020; Mershad & Wakim, 2018). The

teacher's skill performance was evaluated on a five-point scale: professional performance, estimated at 5 degrees, proficient performance, estimated at 4 degrees, Partially Proficient performance, estimated at 3 degrees, and non-proficient performance, estimated at 3 degrees. 2 marks, completely sloppy performance (poor) and is estimated at 1 point, I don't have the skill was not given a mark. Where the skill performance assessment scale included (22) sub-skills, so the maximum score of the skill performance assessment scale becomes = 110 degrees, which reflects the professional (excellent) performance of the teacher in employability of IoT employability skills in the classroom, and the minimum degree = 22 degrees, which expresses the incomplete (poor) performance of the teacher on the IoT employability skills and its educational applications.

To calculate the validity of the skill performance evaluation scale, it was presented to a group of specialists to determine its suitability for the purpose of the current research, the accuracy of its formulation, and its comprehensiveness of the skills represented in it. The necessary modifications were made in the light of the experts' opinions. The internal validity of the scale was also calculated by calculating the matrix of correlation coefficients between the sub-skills and their total score. The values of the correlation coefficients ranged between (0.391-0.924), which were significant values at the level (0.01) and indicated the extent of the consistency of the internal construction of the scale. The stability of the scale was calculated using the "Alpha-Cronbach" coefficient of reliability, and its value was (0.896), which indicated the stability of the scale. Thus, the Self-esteem Scale of IoT skills in its final form was valid for use for the purpose of the current research.

9. Results

9.1. The Result of the First Question

what is the image of the training program designed for teachers in the field of employing the IoT for educational work?

The training program has been designed in the field of employing the IoT in educational work for training teachers on its content remotely through a virtual classroom in the university's Learning Management System (LMS). This is according to the general model for the design of educational and training programs (ADDIE). This model was applied in the following stages:

Analysis Stage: At this stage, the needs of the trainees were identified. They are teachers enrolled in the Diploma in Digital Skills at Imam Abdulrahman bin Faisal University, their ages range between (31- 47) and their scientific specializations vary between social and natural sciences, languages, and Islamic sciences. They also work in different stages of public education between primary, intermediate, and secondary levels, and the general objective of training has been determined, which is to develop teachers' IoT employability skills. The training tool, represented by a virtual class, was identified to carry out the training sessions. As for the training content, it was identified in 3 areas. The first was about knowledge related to the IoT. The second was about the employment of IoT applications in educational work. The third area was related to practical practices / actual applications of the uses of the IoT.

Design Stage: The researcher designed the training package and sessions according to the terms and standards of educational design in terms of title, introduction, objectives and the content of the training package, training activities and enriching learning resources. Training content design: The visualization was built according to previous studies that dealt with the topic (e.g., Al-Aklabi, 2019; Abdel Hamid, 2021; Bajracharya et al., 2018; Mershad & Wakim, 2018).

Development Stage: At this stage, the training processing file was produced in the form of an electronic training package in the form of a file (PDF) and also uploaded to the Learning Management System (LMS) of Imam Abdulrahman bin Faisal University for the purpose of documenting the training production. It is easy to browse through the trainees' personal computer or smart devices through the virtual classroom distance training platform. The researcher obtained information related to the subject of the training program through electronic information sources available on the university's databases and the Internet.

Implementation Stage: The training program was implemented through a number of procedures and training activities through the virtual classroom on the learning management system, where the pre-test was carried out electronically for the trainees before the start of the training sessions and after that the implementation of the training sessions and activities began remotely, so the trainees were introduced cognitive and applied aspects of the IoT and areas of use in educational work. This was done through (6) training lectures (theoretically and practically) in (3) weeks. Each training lecture took two hours simultaneously. This was implemented during the second semester of the academic year 2021/2022 AD, after which the post-test was applied electronically to a sample.

Evaluation Stage: The two types of formative evaluation and final evaluation were used in the empirical treatment of the topic of the research problem, where the formative evaluation was attached to adjusting the training program and its implementation requirements and content in its initial form by presenting it to a group of experts with the evaluation continuing during the experiment process. The final evaluation dealt with during the evaluation of the performance of the trainees after the end of implementation.

Thus, the first question of the research questions, related to building the training program in the field of employing the IoT in educational work, was answered, according to the general model for the design of educational and training programs (ADDIE). This training program was implemented on the research sample to verify its effectiveness in developing skills teachers have IoT as will be evident from the answer to the following research questions.

9.2. The Results of the Second Question

What is the effect of applying the distance training program in developing the cognitive dimension of teachers in employing the IoT in educational work?

To answer this question, the mean, standard deviation, and (t) value of the scores of the trainees in the experimental group were calculated in the pre- and post-test in the cognitive test in the concepts of IoT for educational use. Table 2 illustrates these results.

Table 2

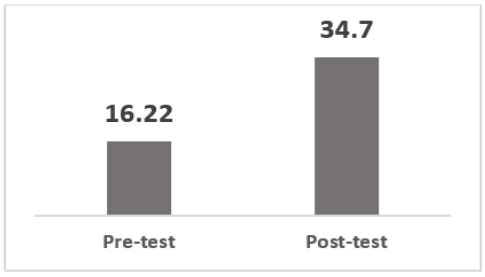
The Mean Scores of the Pre-test and Post-test in the Experimental Group

Test	Pretest		Posttest		df	T	.Sig	(η2)	Effect size
	Mean	SD	Mean	SD					
Cognitive test scores on concepts of the internet of things (40 degrees)	16.22	3.11	34.70	2.87	26	21.09	0.000	0.909	large

The results are also shown in Figure 1.

Figure 1

The Mean of the Pre- and Post-test in Knowledge of the Internet of Things



The results presented in Table 2 and Figure 1 show that there is a statistically significant difference between the performance of the trainees in the experimental group in their scores of the pre and post cognitive test, in favor of their performance in the post test. The mean of their performance in the pre-cognitive test was (16.22) with a standard deviation of (3.11), while the mean of their performance in the post-application of the cognitive test was (34.70) with a standard deviation of (2.87). This means that the training program was effective in developing teachers' knowledge of the concepts of the IoT and its educational applications. Also, the effect size of the difference between the mean scores of the pre- and post-test of the experimental group in knowledge of the IoT was calculated using Cohen's equation (*d*) for correlated samples (Cohen, 1988), and the value of "eta" (η) was 0.953, and the value of the square of eta (η2) 0.909, which indicate a large effect size. This indicates the existence of a "large effect size" of the training program on developing teachers' knowledge of the concepts of the IoT and its educational applications.

The results of the third question: What is the effect of applying a training program on developing the practical skills of teachers in employing the IoT in educational work?

To answer this question, the mean, standard deviation, and (t) value of the scores of the trainees in the experimental group were calculated in the pre and post applications on the IoT self-assessment scale. The results are shown in Table 3

Table 3

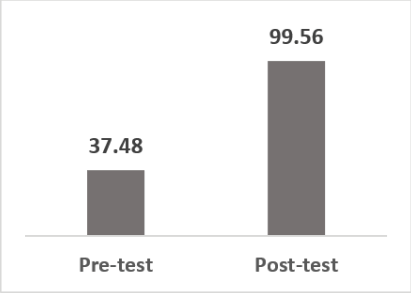
The Mean Scores of the Two Applications, the Pre- and Post- applications of the Trainees in the Experimental Group

Test	Pretest		Posttest		Df	T	.Sig	(η2)	Effect size
	Mean	SD	Mean	SD					
Self-esteem Scale of internet of things skills (110 Degrees)	37.48	9.96	99.56	6.04	26	31.35	0.000	0.937	large

The results are also shown in Figure 2 .

Figure 2

The Mean Scores of the Pre- and Post-test in the Self-esteem Scale of Internet of Things Skills



The results presented in Table 3 and Figure 2 show that there is a statistically significant difference between the performance of the trainees in the experimental group in their scores in the scale of self-assessment of IoT skills in the pre and post applications, in favor of their performance in the post application. The mean of their performance in the pre-application on the self-assessment scale for IoT skills was (37.48) with a standard deviation of (9.96), while the mean of their performance in the post-application on the self-assessment scale for IoT skills was (99.56) with a standard deviation of (99.56) 6.04). This means that the training program is effective in developing teachers' practical/performance skills for using the IoT and employing them in educational work.

Also, the effect size of the difference between the mean scores of the pre- and post-tests of the experimental group trainees in the IoT self-assessment scale was calculated using Cohen's equation (d) for correlated samples (Cohen, 1988). The value of "eta" (η) was 0.968 and the value of (eta square) (η2) was 0.937, which is a value with a large effect size. This indicates a significant impact of the training program in developing practical/performance skills for using the IoT and employing them in educational work.

10. Discussion

The results of the research revealed the existence of "large effect size" which indicate the effectiveness of the training program in developing teachers' knowledge, the research sample, in the concepts of the IoT and their use in educational work. Also, the development of teachers' practical/performance skills for using the IoT and their use in educational work. The teachers' performance improved in the post-application in the cognitive test in the concepts of the IoT, and in the Self-esteem Scale of IoT skills to perform some educational work. This result explains that the design of the package and the training sessions were carried out in accordance with the terms and standards of the educational design, where the content of the training package included the knowledge related to the IoT and its applications in educational work, and actual practices of the uses of the IoT in education. The training content also included many training activities and sources enriched learning. All of this contributed to the development of trainees' knowledge about the concepts of the IoT and their educational applications. On the other hand, the method of implementing training sessions through the virtual classroom helped in improving teachers' knowledge and skills, acquiring training content, and practicing their training activities and tasks easily.

When the training and distance education was planned in the analysis phase, the training need was carefully identified. Planning was considered to overcome the obstacles that teachers might face during training in practical skills to employ the IoT. This is confirmed by previous studies that good planning and considering the potential obstacles to distance training contribute to the success of the organization's training programs when using distance training and education (Cho & Berge, 2002; Saidova & Staricoff, 2022).

On the other hand, the design phase of the training program considered the criteria for effective design of training programs. The continuous evaluation of learning tasks and activities was employed. The effective feedback was provided to teachers during the distance training process. This contributed to improving training outcomes and providing teachers with IoT skills. This is confirmed by the results of previous studies that a good design of distance learning teacher training programs improves their skills in information and communication technology (Gerona & Bautista, 2022). The design of a virtual learning environment in light of the requirements of distance learning has contributed effectively to the development of skills. (Alobeid Allah et al., 2022).

Also, our results are in line with the results of previous studies (e.g., Abdul Raouf, 2020; Alalouny, 2022; Gad, 2022) which showed that teacher training on the concepts of the IoT has a significant impact on teachers' teaching and skills performance, and teachers' acceptance of employing technology IoT to serve educational tasks.

11. Conclusion

The results revealed a positive and large effect of the training program that was prepared for the development of teachers' knowledge and skills about employing IoT in educational settings The study yields some

conclusions. First, the IoT has the ability to change learning and teaching patterns dramatically. Second, the IoT applications can improve the learning experience, individualize learning, consider individual differences among learners, and enhance the freedom of learning. Third, the IoT also has an effective contribution to the development of educational institutions and their systems. The study also concluded that employing the IoT in education, teachers will be able to effectively manage the classroom, teachers will have a new way to manage classrooms using advanced tools, and teachers will be able to change the way they interact with students with the help of digital technologies developed as a result of IoT applications.

12. Recommendations and Future Studies

Based on the results of this study, a set of recommendations and educational applications are presented. These recommendations are hopefully will be as practical applications that help teachers and those in charge of educational institutions in developing the teaching and learning organization. the study recommends the following:

- Developing awareness among teachers and leaders of educational institutions of the uses of the IoT in accomplishing education tasks and developing educational services through more design and implementation of training programs and specialized seminars.
- Increasing awareness among secondary school students of the applications of the IoT and their importance in developing many aspects of life, and the necessity of their orientation to study this specialty in their university studies.
- The importance of training teachers and qualifying them educationally and technologically on the use of smart systems in education and keeping pace with the resulting developments in learning theories and educational products under artificial intelligence.
- The necessity of providing teachers with the concepts of the Fourth Industrial Revolution and enabling them to employ its technologies because of their importance in improving their teaching performance, developing more flexible teaching strategies, and tools for evaluating students' performance, as well as developing their abilities to deal with modern technologies.
- The study also recommends conducting more research and future studies that deal with the relationship between the services of the IoT and its applications and the completion of the work of educational institutions and their routine tasks. As well as conducting research on the impact of developing students' knowledge and skills in employing the IoT on their academic performance and innovations in the practices of educational activities.

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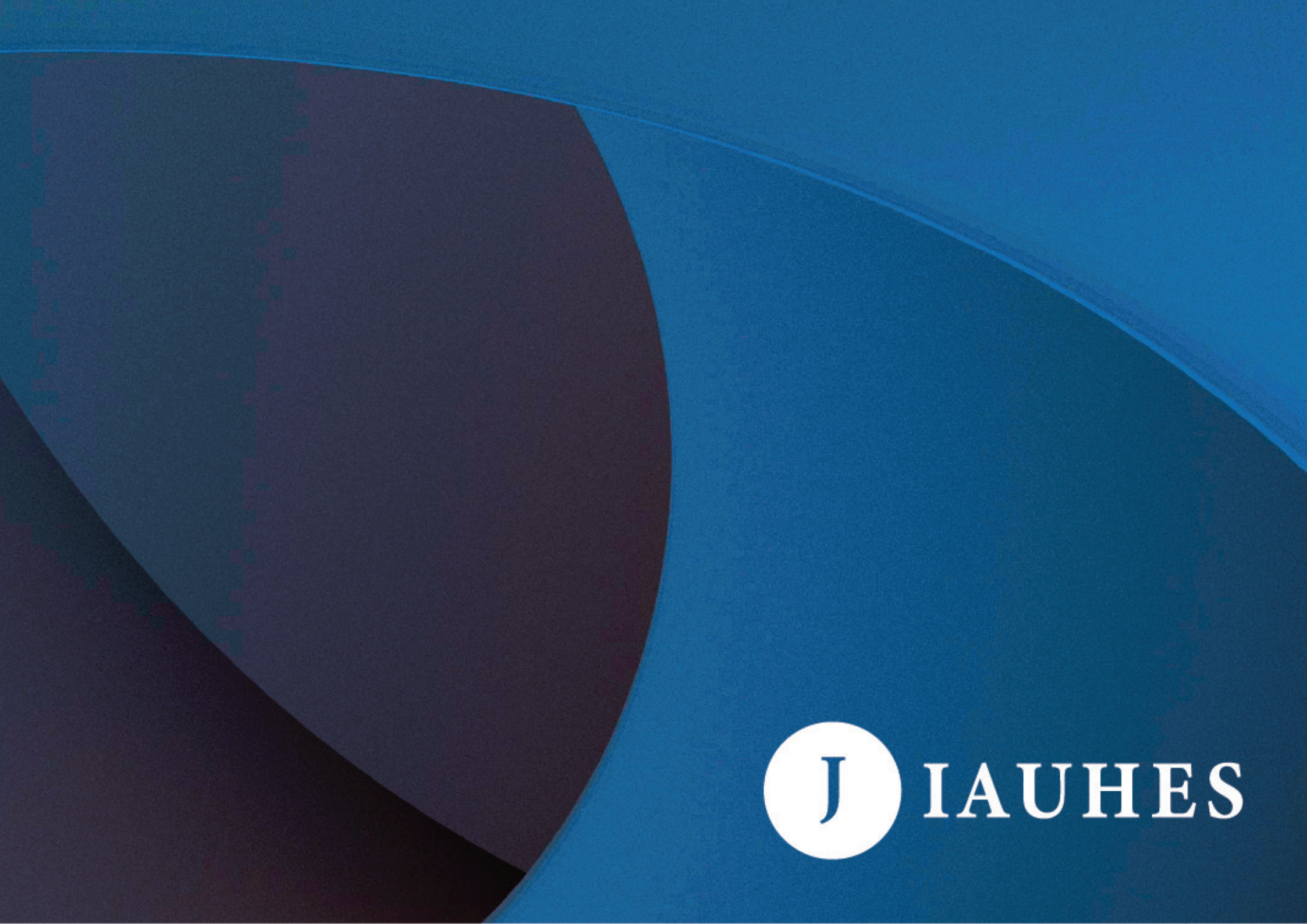
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