

The Degree of Awareness of Graduate Students in Jordanian Universities of the Importance of Using Internet of Things (IoT) Technology in the Educational Process

By

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Abstract

This study aimed to determine the degree of awareness of graduate students in Jordanian universities regarding the importance of using Internet of Things technology in the educational process. The study was conducted during the second semester of the academic year 2022-2021 AD. The survey descriptive approach was used, and the study tool (the questionnaire) consisted of (54) items, distributed on four categories that included (the concept of IoT technology, uses of IoT technology, benefits of IoT technology, and challenges of IoT technology). The study sample consisted of (439) male and female graduate students in Jordanian universities, who were randomly selected. The study concluded that the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process was at a high level. It also offered a number of recommendations, most notably the need to reconsider the construction of modern educational curricula, provide the opportunity to include university courses specialized in IoT technology, and approve them within modern study plans.

Keywords: Degree of Awareness; Graduate Students; Jordanian Universities, Internet of Things Technology.

Introduction

The Information and Communication Technology (ICT) sector has developed in recent times at a great speed, and the world has witnessed rapid changes and global challenges, especially with the advent of the Fourth Industrial Revolution, which worked to bring fourth and create great and radical changes in various sectors, including the educational sector, since technological advances were spreading worldwide. Successive technological developments contribute to providing many life requirements for individuals and are considered one of the most prominent and most important challenges that have imposed themselves on various aspects of life, including primary and university education. These challenges impose the need to develop education systems on universities, which would transform them from being traditional to becoming modern.

The era of the Fourth Industrial Revolution imposed tremendous educational transformations on universities, their policies, objectives, curricula, teaching methods, and evaluation systems. The most important role imposed on them is to interact strongly with the available ICT, as, through technology in all their forms, they will enrich the educational

process, renew educational systems, develop learner skills, and create the shift from the process of consuming knowledge to its production (Amin, 2018). Thus, many countries and governments encouraged institutions working in educational fields with regard to integrating technology in educational policies in order to transform educational classrooms into interactive (school) environments. (Irgatoglu, 2021).

The continuous development in the world of the Internet has brought about many changes in today's world, and is moving into a new generation, which is called the IoT technology, which has begun to spread in the world of ICT recently. This sector is considered one of the fastest growing and developing technological sectors in the current century, and through these technology, you can communicate with and control the operation of electronic devices using the Internet, which is a tool for processing data via radio frequency and sensor technology, smart technology and other types of technologies (Sopapradit & Piriyaawong, 2020). Institutions operating in the educational sector have been affected by these digital developments, and need to keep pace with them and use them as interactive electronic tools to achieve learning goals, bring about radical and important changes in the educational system and develop its capabilities and teaching methods (Al-Aklaby, 2019).

Based on the above, and in order for universities to achieve the desired educational goals and strategies in a highly competitive technological environment, they must comprehend the changes that have occurred in the field of modern technological technologies, and employ the IoT technology in the educational process, for them to be in the ranks of universities with prestigious international rankings. It can be said that the use of IoT technology in the educational process is urgent at the present time; therefore, the idea of the study crystallized to determine the importance of this technology and to determine the degree of awareness of graduate students of the importance of using it in the educational process.

Study Problem and Questions

The step of digital transformation and the employment of modern technology processes such as the IoT technology has become the start of change and the launch of an educational system that catches up with international developments, especially in education in universities, since universities are considered one of the driving centers for sustainable development in societies (Palanivel, 2020; Khawlani, 2021). The stage of graduate studies in universities is one of the specialized stages in higher education, as it provides societies with a selection of specialized and qualified leaders in different disciplines and in areas that are mainly needed by society, and therefore represents an important and essential element of sustainable and comprehensive development that is concerned with establishing a solid base in scientific research and qualifying researchers by using modern technologies in the field of education (Al-Daraan, 2020). Therefore, the Jordanian Ministry of Higher Education and Scientific Research has been keen to implement the royal desires and directives related to moving forward in adopting the new technologies and raising the efficiency of Jordanian youth in a way that helps improve the quality of the educational process and is compatible with smart systems (Ministry of Higher Education and Scientific Research, 2022b).

Referring to the recommendations through similar previous studies such as the studies of: Al-Aloni (2022), Palanivel (2020), Al-Aklaby (2019), and Al-Dahshan (2019), these studies recommended the necessity and importance of using IoT technology in the educational process, in addition to the need of Higher Education institutions to implement IoT technology policies

in universities, elevate the capabilities of university students, and stay up to date with modern technologies such as IoT technology. Also, by referring to the recommendations of some conferences, such as the international conference entitled “The Fourth Industrial Revolution and Its Impact on Education”, which was held in Oman (2019), where the conference recommended developing all elements of the educational system and keeping pace with the requirements of the Fourth Industrial Revolution and its recent developments such as the IoT and the preparation of graduate students for modern jobs in the future (Al-Shibli, 2019). The study problem was to answer the following question: What is the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process?

Theoretical Framework and Previous Studies

Given the tremendous technological progress that the world is witnessing in various areas of life, such as education in particular, this has led to the world being a small village, and there has become a necessary and definite need to keep pace with this technological development. The IoT technology facilitated the communication processes between all the elements of the educational system and allowed flexibility, which was reflected in the educational process, and this matter led to the educated person being the center of the modern educational process and not a passive recipient, as the situation was in the past, but an interactive participant, which encouraged the development of different skills which they have and raise the level of achievement and motivation (Mohamed, 2021; Metwally & Mabrouk, 2020).

The beginning of the emergence of IoT technology dates back to the early eighties when the first device, a “cook device”, was connected to the Internet at Carnegie Mellon University, where this machine was able to report the stock of the drink inside, but this concept did not appear widely at that time (Kenawy, 2021). Mark Weiser presented the research paper entitled "The Computer for the 21st Century" in the year 1991 AD, and it formed the contemporary vision of the IoT technology. The year 1999 AD is considered as the first real breakthrough for this technology thanks to Kevin Ashton, the British technological innovator and director of the Massachusetts Institute of Technology, when he built on Weiser's ideas for ubiquitous computing, which were described in his 1991 AD (Scientific American) article that a future would consist of interconnected computers, which were designed to weave themselves into the fabric of everyday life and become so indistinguishable from it. Ashton coined the term IoT when he gave a presentation at (Procter & Gamble) on integrating (Radio-frequency Identification, RFID) tags into their supply chain to enable computers to gather information on their own. He also identified the capabilities of the new technology in creating, processing and storing data by devices without any human intervention (Chin, Callaghan & Allouch, 2019). All studies related to IoT technology was adopted by the International Telecommunication Union and published in its annual report in (2005) AD, and in (2008) AD, The International Federation for Internet of Things Technology was formed, and after four years another version of the Internet protocols was released, which is the sixth Internet Protocol (IP6) which enabled anything to get a unique address of its own without any obstacles, allowing communication between a large number of things (Al-Aklabi, 2017).

The term IoT technology, which was developed, consists of two words, “Internet” and “Things.” The Internet is a global system of interconnected computer networks where Internet protocols (TCP/IP) are used to serve billions of users around the world and connect things and

people, while "things" are everything that can be connected to this network via a special protocol (Sultana & Tamanna, 2022). IoT technology refers to all devices that can work on the World Wide Web, and which can collect, send and process the data it collects in various surrounding environments, using built-in sensors and processors in addition to communication media and benefit from them in education (Altinpulluk & Kilinc, 2022; Kuldeep, 2022).

Previous Studies

Al-Aloni study (2022), which aimed to identify the opportunities and challenges associated with the employment of IoT technology in the Saudi university sector from the point of view of the faculty members. This study followed the descriptive method, and it applied a tool represented in open interviews with (23) study samples to know the most important opportunities and challenges that they may face through the IoT technology in these universities. It consisted of seven areas (education and learning, human resources, energy, transportation, public utilities, safety and security, and data analysis). Its results showed multiple opportunities from the IoT technology at the university, which can effectively contribute to improving educational and environmental processes, such as: sending notifications associated with smart systems, using smart chairs, monitoring heating and air conditioning systems, providing the necessary energies, controlling automated shutdowns and electronic operation of facilities. In addition, some challenges emerged, represented by the weakness and interruption of the Internet, data penetration through some existing security vulnerabilities, in addition to weak infrastructure.

Al-Khatib study (2021), which aimed to know the degree of awareness of workers in Information Technology (IT) departments about the applications of IoT technology in libraries in Jordanian universities and the challenges facing them. A descriptive survey method was used, and its population included a group of (96) workers within the IT departments within these libraries in the academic year 2020-2021. It also developed a questionnaire to achieve its objectives. The results showed that the degree of awareness of workers in the IT departments related to IoT technology applications within university libraries was high, and they showed that the challenges and difficulties that IT departments may face when applying IoT technology also were high, and that the most important difficulties they face were financial difficulties and lack of training programs for employees.

The study of Al-Maamari, Al-Kindi, Al-Dhuli, and Al-Farsi (2019), which aimed to identify the motivation of the faculty members in the Information Studies Department to use the IoT technology, to identify the extent to which undergraduate students in the IT Studies Department incorporate IoT technology in the education process, and to reveal the obstacles to its use. It used the descriptive analytical approach using the questionnaire tool, and it was conducted in December of the year 2018 (AD). Its community consisted of faculty members in the Information Studies Department at the College of Arts and Social Sciences at Sultan Qaboos University, and students of the seventh and eighth semesters of the Information Studies major. The sample consisted of (30) male and female students and (5) faculty members. Among the most prominent findings of the study is that the most motives that encouraged faculty members to use the IoT technology is its use in scientific research, linking IoT technology units with the reality to be simulated, facilitating attendance registration processes, and receipt of costs and duties. In addition, they showed the presence of acceptance by students to using the IoT technology because it diversifies the methods of explaining the curricula and facilitates the process of understanding scientific concepts, as well as it was easily used by students. As for

the most important obstacles to using this technology, they are represented in the weak infrastructure, and the fear of violations, cyber-attacks and health complications.

Taha (2018) conducted a study aimed at identifying the digital revolution of IoT technology and its use in the educational process at Taif University. It was conducted and analyzed during the second semester of the academic year 2010-2011 (AD) and used the descriptive analytical approach. It reviewed the development of the use of IoT technology in daily life and how to employ it in the educational process at Taif University, as well as determining the foundations for achieving application efficiency and how beneficial is its activation. The study reached important results, the most important of which is the diversity in the use of IoT technology, such as the possibility of designing things, starting from adding sensors to designing smart devices, controlling things, and the distribution of IoT technology solutions that control, monitor and manage things, allowing real-time data capture and analysis, to identify insights for outstanding business, which creates new opportunities to increase revenues. Also, they indicated that this technology works to achieve smart security, and provides Interactive applications in the education sector that contributed to raising its efficiency, such as enabling a faculty member to create three-dimensional graphic books, monitoring learning progress, evaluating performance and results, and improving the learning experience.

Al-Aklaby (2019) prepared a study that aimed to identify the return from the applications of IoT technology to the educational process. The descriptive analytical approach was used, and previous studies were reviewed for what was previously addressed in the fields of IoT technology and the educational process. It reached a set of results represented in the most important challenges facing the application of IoT technology in the educational process, such as expansion and difficulty in controlling devices, cyber attacks, lack of infrastructure readiness, lack of regulatory legislation, privacy violation, lack of unified and specialized standards and protocols, high cost of maintenance and implementation, the need of a professional team and training users in the educational system to use this technology, in addition to the negative health and psychological effects, and the risk of harmful programs. It also presented the most important benefits of IoT technology in the educational process, such as the possibility of effectively contributing to the development of educational institutions services, providing smart education and smart classes, automation of attendances and absences, enabling parents to follow up with their sons. In addition, this technology has a role in the service of scientific research, the formation of global participatory cooperative groups among faculty members, and the development of artificial intelligence capabilities, which contributed to the real increase of things connected to the Internet.

Study Methodology

The study used the descriptive survey method to achieve its objectives and answer its questions. Its community consisted of all graduate students in Jordanian universities (public and private) and their number reached (29,520) students in the academic year 2021-2022. (Ministry of Higher Education and Scientific Research, 2022a). Its sample consisted of (439) male and female students, who were randomly selected according to the sample size schedule provided in (Al-Najjar et al., 2018). Relying on the questionnaire as a tool for the study, and after reading the theoretical literature and similar studies, the tool was developed, and the validity and reliability of all its parts were verified. The first part contained the demographic data of graduate students, while the second part included (54) items distributed over four categories, namely: concept of IoT technology, uses of IoT technology, benefits of IoT technology, and challenges of IoT technology). The five-point Likert scale (very high, high,

medium, low, very low) was used. To test the apparent validity of the study tool, it was presented and judged by a group of experts in curricula, teaching methods, educational technology, measurement and evaluation in Jordanian universities to take their views in the items of the tool as well as to make any modifications they deem appropriate.

The study also verified the structural validity of the tool and was applied to a simple sample consisting of (30) male and female students from outside the study sample. The Pearson correlation coefficient was calculated and the level of significance of the items' correlation coefficients was extracted with the category to which they belong and with the tool in general. The results indicated that the internal validity of the items in all categories was acceptable, as the significance value was less than 0.05, except for item No. 2 in the first category, as the significance level was greater than 0.05, which was not acceptable, and therefore it was deleted from the category. The stability of the study tool was confirmed using Cronbach's alpha test, where the results indicated that the stability coefficient of the tool as a whole was (0.974) and that the stability coefficients of the categories ranged between (0.899-0.948) and that these values were higher than (0.7) so they were considered acceptable, and thus the tool was suitable for use. The statistical analysis was also carried out through the Statistical Package in Social Sciences (SPSS) program, where a set of statistical methods were used to find out the results of the study and answer its question by calculating (arithmetic means, standard deviations, rank, and degree).

Results

In order to answer the study question, which states: “What is the degree of awareness of graduate students in Jordanian universities of the importance of using Internet of Things technology in the educational process? Arithmetic means, standard deviations, and ranks were calculated for the degree of awareness of graduate students in Jordanian universities regarding the importance of using IoT technology in the educational process. Table No. 1 shows these results.

Table (1) Arithmetic means and standard deviations of the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process, arranged in descending order according to arithmetic means

Category	Arithmetic Mean	Standard Deviation	Rank	Degree
The First Category: The Concept of IoT Technology	3.85	0.671	1	High
The Fourth Category: Challenges of IoT Technology	3.79	0.683	2	High
The Third Category: Benefits of IoT Technology	3.78	0.697	3	High
The Second Category: Uses of IoT Technology	3.76	0.685	4	High
The Tool as a Whole	3.79	0.597		High

The results show that the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process was high, as the arithmetic mean percentage of the tool as a whole was (3.79) and the standard deviation was (0.597). The degree of awareness in all categories was high, as the arithmetic means percentage of these categories ranged between (3.76-3.85) and these results are considered high. As for the results of the categories in detail, they were as follows:

The first category: in which the study calculated the arithmetic means and standard deviations of the answers of the study sample members about the items of the first category (the concept of IoT technology). This category consisted of (8) items arranged in descending order according to the results of the arithmetic means as shown in Table No. 2.

Table (2) Arithmetic means and standard deviations of the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process for the category of (the concept of IoT technology) arranged in descending order according to arithmetic means

Item No.	Item	Arithmetic Mean	Standard Deviation	Rank	Degree
1	IoT technology is a developed generation of the Internet in which things are connected to each other or to the Internet in order to achieve interaction and send and receive data at any time and place.	4.04	0.861	1	High
4	IoT technology contributes to providing a wealth of information and data.	4.03	0.901	2	High
8	IoT technology contributes to the control, collection, analysis, and reinterpretation of Big Data in predicting future decisions related to student performance.	3.86	0.813	3	High
2	IoT technology creates collaboration groups with other faculty members to exchange information and share interests.	3.85	0.903	4	High
7	IoT technology is enhanced by sensors and motors, which are electronic-physical systems that include many smart technologies such as smart learning.	3.83	0.877	5	High
5	IoT technology controls devices remotely through the existing network infrastructure.	3.81	0.934	6	High
6	IoT technology allows direct integration of the physical world into computer systems.	3.79	0.879	7	High
3	IoT technology is based on linking scientific concepts with real reality by simulating it.	3.76	0.937	8	High
The Category as a Whole		3.85	0.671		High

The results indicated that the degree of awareness of graduate students in Jordanian universities regarding the importance of using IoT technology in the educational process for the category of (the concept of IoT technology) in general was at a “high” degree, with an arithmetic mean of (3.85) and a standard deviation of (0.671). The arithmetic means of all items of this category ranged between (3.76-4.04), with standard deviations ranging between (0.813-0.937), all of which are considered at a high degree. Item No. (1) obtained the highest arithmetic

mean of (4.04) and standard deviation (0.861), while item No. (3) obtained the lowest arithmetic mean of (3.76) and with a standard deviation of (0.937).

The second category: in which the study calculated the arithmetic mean and the standard deviation of the answers of the study sample members about the items of the second category (the uses of IoT technology). This category consisted of (9) items arranged in descending order according to the arithmetic means as shown in Table No. 3.

Table (3) Arithmetic means and standard deviations of the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process for the category of (uses of IoT technology) arranged in descending order according to arithmetic means

No. Item	Item	Arithmetic Mean	Standard Deviation	Rank	Degree
10	IoT technology enables access to information and research through smart libraries.	3.90	0.892	1	High
11	IoT technology provides computing services and resources through cloud computing.	3.89	0.844	2	High
9	IoT technology provides the user with lending, repaying and electronic payment services in libraries through smart phone applications.	3.89	0.914	3	High
17	IoT technology makes it easier to use voice assistants like Google Assistant for education and easy access to resources.	3.86	0.850	4	High
12	IoT technology enables faculty members to create smart classrooms, smart labs, and implement interactive experiments.	3.75	0.895	5	High
14	IoT devices are used to build smart systems such as smart lighting, locks, thermostats, speakers and doorbells.	3.72	0.985	6	High
16	IoT technology is used with wearable smart applications (such as smart watches) to provide, analyze, and use data on students to make smart decisions.	3.65	0.958	7	Medium
15	QR codes are used to help students easily get feedback, assignments, and additional knowledge resources.	3.63	0.922	8	Medium
13	The educational robot is used in libraries with the help of IoT technology to perform several tasks, including accuracy in work.	3.57	1.0130	9	Medium
The Category as a Whole		3.76	0.685		High

The results of this category showed that the degree of awareness among graduate students in Jordanian universities of the importance of using IoT technology in the educational process was high, with an arithmetic mean of (3.76) and a standard deviation of (0.685), and

all the items got scores between (medium to high) with arithmetic means ranging between (3.57-3.90) and standard deviations ranging between (0.850-1.0130). Item No. (10) got the highest arithmetic mean of (3.90), with a standard deviation of (0.892), while item No. (13) got the lowest mean of (3.57) with a standard deviation of (1.0130).

The third category: the arithmetic means and the standard deviations of the answers of the study sample members about the items of the third category (benefits of IoT technology) were calculated. It consisted of (20) items arranged in descending order according to the arithmetic means as shown in Table No.4.

Table (4) Arithmetic means and standard deviations of the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process for the category of (benefits of IoT technology) arranged in descending order according to arithmetic means

No. Item	Item	Arithmetic Mean	Standard Deviation	Rank	Degree
22	IoT technology serves scientific research.	3.97	0.901	1	High
23	IoT technology allows faculty to access high-quality educational materials and change traditional teaching methods.	3.91	0.947	2	High
37	IoT technology contributes to giving the educational process a global image and increasing the interaction between students and all scientists and researchers from all over the world.	3.86	0.857	3	High
24	IoT technology enables learning to automate and track attendances and absences of students in the classroom.	3.86	0.912	4	High
32	IoT technology eliminates the need for physical storage of books by providing them as e-books, which contributes to a better learning experience.	3.86	0.946	5	High
19	IoT technology helps students manage their learning and transcend the boundaries of space and time.	3.85	0.897	6	High
25	IoT technology improves the efficiency of educational institution management by allowing administrators to monitor corridors and classrooms.	3.80	0.895	7	High
29	IoT technology improves students' experience in the educational environment.	3.78	0.898	8	High
34	IoT technology supports students with special needs and provides them with smart devices and aids.	3.78	0.942	9	High
31	IoT technology provides smart board applications that facilitate the explanation of lessons for faculty members.	3.78	0.952	10	High
36	IoT technology facilitates scientific concepts for students.	3.77	0.888	11	High
35	IoT technology increases energy efficiency and saves costs, as lighting can be programmed and set to a schedule, or connected to sensors and programmed to turn off when the classroom is empty.	3.77	0.931	12	High
20	IoT technology enables parents to monitor their children's achievement and communicate with them, the teacher, and the administration.	3.76	0.964	13	High
26	IoT technology contributes to decision-making and data collection in real time.	3.75	0.953	14	High
21	IoT applications help keep students and faculty members safe in educational institutions.	3.73	0.904	15	High
28	IoT technology allows students to track learning progress and evaluate performance and results	3.73	0.914	16	High
18	Students interact with their peers through the IoT technology better than in a traditional learning environment.	3.71	0.965	17	High
30	IoT technology provides interactive and simulation applications that enable faculty and students to create 3D graphic books and take notes.	3.70	0.983	18	High
27	IoT technology improves student outcomes.	3.63	0.958	19	Medium
33	IoT technology enables personalized learning and takes individual differences into account.	3.63	1.019	20	Medium
The Category as a Whole		3.78	0.697		High

The results of the study showed that the degree of awareness among graduate students at Jordanian universities of the importance of using IoT technology in the educational process for the category of (benefits of IoT technology) was at a high degree, with an arithmetic mean of (3.78) and a standard deviation of (0.697). All items got scores between (medium to high) with arithmetic means that ranged between (3.63-3.97) and standard deviations that ranged between (0.857-1.019). Item No. (22) received a high arithmetic mean of (3.97) with a standard deviation of (0.901), while Item No. (33) got the lowest arithmetic mean of (3.63) and a standard deviation of (1.019).

The fourth category: the arithmetic means and standard deviations of the answers of the study sample members to the items of the fourth category (challenges of IoT technology) were calculated. It consisted of (17) items arranged in descending order according to the arithmetic means as shown in Table No. 5.

Table (5) Arithmetic means and standard deviations of the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process for the category of (IoT technology challenges) arranged in descending order according to arithmetic means

No. Item	Item	Arithmetic Mean	Standard Deviation	Rank	Degree
44	The need for specialized infrastructure.	3.95	0.903	1	High
42	The implementation of IoT technology in educational institutions requires the provision of special hardware and software.	3.91	0.938	2	High
43	The need for faculty and students to have good training and skills in using and dealing with IoT technology.	3.90	0.896	3	High
41	The implementation of IoT technology in educational institutions requires a specialized team.	3.86	0.931	4	High
54	There is a risk that many jobs will disappear due to relying on IoT technology to manage tasks instead of people.	3.86	0.938	5	High
50	The need for a specialized administration that provides assistance for integrating IoT technology into the educational institution's classrooms and curricula.	3.84	0.952	6	High
47	The high cost of implementing and maintaining IoT technology in educational institutions.	3.83	0.945	7	High
45	Devices that are related to provide services in IoT technology and scalability don't go hand in hand	3.77	0.902	8	High
38	The difficulty of controlling devices and machines connected in the IoT technology in the future due to the steady increase in their number.	3.76	0.912	9	High
46	The spread of viruses and malware reduces the efficiency of IoT technology and harms it.	3.76	0.967	9	High
51	Lack of unified common standards and protocols in IoT technology.	3.76	0.975	11	High
39	Weak and interrupted Internet connection.	3.74	0.968	12	High
49	Legislation shortcomings by governments to support new technologies such as the IoT technology.	3.74	0.954	13	High
52	Failure to adhere to the concept of security by manufacturers of IoT technology devices, which causes security flaws in their devices and applications.	3.72	0.896	14	High
40	Cyber attacks and violation of users' privacy.	3.72	1.010	15	High
53	IoT technology leads to many social, psychological, and health problems that affect the behavior of users.	3.69	1.007	16	High
48	IoT technology consumes energy.	3.61	0.925	17	Medium
The Category as a Whole		3.79	0.683		High

The results indicated that the degree of awareness of graduate students in Jordanian universities regarding the importance of using IoT technology in the educational process for the category of (challenges of IoT technology) was high in general, with an arithmetic mean of

(3.79) and a standard deviation of (0.683). All items obtained scores between (medium to high) with arithmetic means between (3.61-3.95) and standard deviations between (0.896-1.010). For example, item No. (44) got the highest arithmetic mean of (3.95) with a standard deviation of (0.903), while item No. (48) got the lowest arithmetic mean of (3.61) and a standard deviation of (0.925).

Discussing the Results

The results showed that the degree of awareness among graduate students within Jordanian universities of the importance of using IoT technology in the educational process was high in all categories. According to the researchers, this explains the fact that the IoT technology was integrated strongly and quickly into Jordanian society and the higher education sector in particular. Consequently, students used in various stages of education. Also, there are several reasons that may have contributed and played a major role in improving and raising the levels of awareness among students, including the development of services provided by Jordanian telecommunications companies and the level of competition among them; this played an important role in the spread of Internet services, reducing the prices and costs of technological services, in addition to the programs they provide to public and private educational institutions, which would contribute to the spread of ICT and modern technologies and services among students in general and graduate students in particular. These results also indicated that the development, modernity, and changes in the nature of the business market and the requirements of modern jobs, as well as the aspiration for expertise and advanced technological skills, all led to the development of qualitative and modern specializations. Moreover, the introduction of IoT technology in most university majors to qualify generations and graduate students and keep pace with the needs of the labor market encouraged students to learn and build a strong relationship with modern technology, which contributed to raising students' awareness of this technology. The study agrees with this result with the study of Al-Khatib (2021).

The results indicated that the degree of awareness of graduate students in Jordanian universities of the concept of IoT technology was high, as both researchers indicate that this technology has become an integral part of the student's life and provides them with a huge wealth of information, as Jordanian universities provided halls for students equipped with the Internet, which facilitated the interaction between students and faculty members and the formation of scientific research seminars. The result in the category as a whole agreed with some studies that referred to the concept of IoT technology and its role in educational interaction, such as the studies of Al-Aklabi (2019) and Taha (2018).

The results showed that the degree of awareness of graduate students in Jordanian universities of the uses of IoT technology in the educational process was high, as they used this technology through scientific research, and this required them to make extensive use of smart libraries and smart phone applications that depend on IoT technology. The study agrees in its results with the study of Al-Muzayen (2021); the researchers also added that students use technologies based on IoT technology, especially after the Corona pandemic, both face-to-face and online through many educational platforms provided by Jordanian universities such as (Zoom) and (Teams), which allows holding meetings and online lectures, and the use of video projectors, screens, tablets, and interactive whiteboards in smart classrooms. This result agreed with what was indicated by the studies of Al-Alouni (2022) and Taha (2018).

The degree of awareness in regards to the category of benefits was at a high degree, and the results are attributed, according to the researchers' opinion, to the fact that graduate students have awareness of the benefits of IoT technology in scientific research; this is because a graduate student uses IoT technology to collect the necessary scientific material for a Master's or Doctoral thesis, or any other research he needs, as most of the scientific research institutions publish, through their websites on the World Wide Web, the names of the books they have, and these researches, books, or Master's theses are available free of charge or for a small amount of money. Thus, this result agrees with some studies that indicated the importance of IoT technology in scientific research, such as the study of Al-Maamari et al. (2019). The results also indicated that students have a consensus and a high awareness of the benefits of IoT technology in the educational process, as they noticed its impact on improving their learning better from traditional environments, especially when Jordanian universities, after the Corona pandemic, relied on platforms and applications based on IoT technology; for example, students use videos, presentations, and forums, which increases their interaction with students, as well as faculty members. Furthermore, students can communicate with scientists and researchers from all over the world without fear, and without geographical or time barriers via the Internet.

On the other hand, the results showed that students are aware of the most challenges they face when applying IoT technology in the learning process, such as the need for a specialized infrastructure that provides hardware and special software for some applications such as simulation programs and virtual reality, in addition to the need for strong Internet networks that support communication, because some students, especially those who live in remote or remote places, suffer from intermittent Internet and poor communication, especially during the broadcast of lectures that are online. Also, some students do not have the technological skills to deal with online platforms or applications, especially in their first semester, so they are aware of the need for training. The results also reflected students' awareness of cyber attacks and the violation of online privacy, the high costs of maintenance and implementation, and the risk of job disappearance. The results agreed with what some previous studies had interpreted as challenges, such as the studies of Al-Alouni (2022), Al-Maamari et al. (2019), and Eleyyan (2021).

Recommendations

- The Jordanian Ministry of Higher Education and Scientific Research should refocus on the regulations and laws regulating modern technologies and e-learning, and develop national plans that include teaching IoT technology in Jordanian universities.
- Providing infrastructure in universities and providing them with modern equipment, laboratories, and software to train students and members of academic and administrative bodies in the subject of IoT technology, and to provide universities with qualified technical and academic teams to deal with this technology.
- The need for the Jordanian university administration to give greater importance to the issue of IoT technology and to focus on its importance in interpreting educational data.

Suggestions

Based on the findings and recommendations, the study suggests conducting studies that:

- Related to applying the degree of awareness of the importance of using IoT technology in the educational process to other samples, such as undergraduate students or faculty members in Jordanian universities.
- Deal with identifying the difficulties facing graduate students from their point of view when dealing with modern technology and finding solutions for that.

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