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Differences in the degree of awareness of graduate students in Jordanian universities of the importance of using internet of things (IoT) technology in the educational process

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Abstract---This study aimed to identify the differences in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process based on the variable (university classification, academic level, and faculty classification). This study was conducted during the second semester of the academic year 2022-2021 AD. The descriptive survey method was used, and the study tool (the questionnaire) consisted of (54) items. It was divided into four categories (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 chosen randomly. The results of the study showed that there were no statistically significant differences in the degree of students' awareness due to the university classification variable, and that there were statistically significant differences due to the academic level variable in favor of the Master's stage, as well as the presence of statistically significant differences due to the faculty classification and in favor of the humanities faculties. Thus, the study recommended the need to reconsider the methods of preparing modern educational curricula, including university courses specialized in IoT technology topics, and including them in the new study plans.

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

Introduction

The Internet of Things (IoT) network is considered one of the complex and intelligent networks as a result of its ability and capabilities in most cases to manage many businesses. It has also become one of the most important features and characteristics of the Fourth Industrial Revolution, which combined various digital and physical manifestations. This network has proven a major role in providing opportunities that allow strong exposure to modern societies and has been highly relied upon because it has many opportunities and quality services in different ways for educational environments, including university, which were represented in many forms such as smart classrooms, smart energy, smart security, and assistance in decision-making. This helped meet the needs of individuals who benefit from modern educational systems and improve the atmosphere of work environments (Al-Alouni, 2022). It can also be noted that the IoT technology contains a number of applications that are used in higher education institutions, and through which controllers and remote sensors are used to connect with distinguished and smart academic institutions that can manage all university facilities and expand using IoT platforms and cloud computing to remove various barriers and access to better education (Banica, 2017).

IoT technology offers great and distinct opportunities in the field of higher education. It will also lead to the complete reform and development of educational institutions, and contribute to changing the components of the university campus and making changes to the teaching and educational processes, as well as the transformation from traditional systems to modern and interactive educational systems. Faculty members can follow up students and teach them according to their varied needs. (Mishra, Karthikeyan, Barman, & Veettil, 2020).

On the other hand, IoT technology has a greater impact on higher education when compared to other types and stages of education, due to the fact that the nature and characteristics of higher education are more open and in line with the innovation and integration processes of teaching and research technologies. (Romero, Alonso, Marín & Gomes, 2020). Higher education is considered one of the secrets of success for any country at the economic, social, intellectual and political levels, which requires more attention to its institutions and their development because of its crucial role in the development of various aspects of the state and society, as it represents the gateway to entering the modern era through its institutions and contributes to the advancement of man with his skills and ideas to be creative and productive (Al-Dahshan & Al-Sayed, 2020).

Based on the foregoing, in order for university educational institutions to be able to achieve all the required educational goals in the presence of highly competitive technological environments, they must keep pace with modern technological changes, and employ IoT technology in the educational process as a tool of development tools for universities to ensure a position among universities with prestigious international rankings. It can be said that the importance of IoT technology in education has become a necessity at the present time, and accordingly, the idea of studying the differences in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT

technology in the educational process was crystallized, in addition to its benefits and the most important challenges it faces.

Study Problem and Questions

The processes of digital transformation and the employment of advanced technology such as the IoT have become the beginning of change in the educational process in various fields, as well as the beginning of change and the launch of an educational system that catches up with developments in the world, especially in the fields of university education, as universities are one of the centers of the sustainable development movement in societies. IoT technology enhances and increases the efficiency of the educational process and transforms it from the traditional stage of learning to smart learning (Palanivel, 2020; Al- Khulani, 2021). The university postgraduate studies stage represents an important and specialized stage in higher education, as it provides societies with a group of qualified leaders and specialists in various sciences and fields that society needs in general; therefore, it is considered one of the most important elements of sustainable and comprehensive development that aims to build and establish a solid base in the scientific research process and qualifying a group of researchers through the use of advanced modern technologies in the educational process (Al-Daraan, 2020). The Jordanian Ministry of Higher Education and Scientific Research was keen to implement the royal wishes and directives practically, especially with regard to moving forward in employing modern technologies such as the IoT technology in education, and striving at the highest levels to provide a proper infrastructure for this technology on the university campus to raise the scientific status of higher education institutions (Ministry of Higher Education and Scientific Research, 2022b).

Referring to the recommendations of previous studies, such as the studies of Palanivel (2020), Al-Aklabi (2019), Meacham, Stefanidis, Gritt and Phalp, (2018), which recommended the need to use IoT technology in the educational process and the increasing need for the Ministry of Higher Education to adopt IoT technology policies in universities, due to the increasing need to raise the capabilities of university students and keep pace with modern technologies such as IoT technology. Also, after referring to the recommendations of some conferences that were held to discuss and research this topic such as the international conference entitled "The Fourth Industrial Revolution and its Impact on Education" in Oman (2019), where the conference recommended the need to improve the elements in the educational system and keep pace with the requirements of the fourth industry revolution, technology, what it includes of modern technologies such as the IoT, and the qualification of graduate students for modern jobs in the future (Al-Shibli, 2019). The problem of the study was represented by the following question:

Are there statistically significant differences at the level of significance ($\alpha = 0.05$) in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology based on the variables of (university classification, academic level, faculty classification)?

Theoretical Framework and Previous Studies

With the increase in the recent trends of institutions towards digitization and the use of modern technology, including the IoT technology, great changes have occurred in various aspects of life such as the education environment, which in turn eliminated most of the barriers and obstacles that reduced communication processes between people such as language, time, place and culture. Therefore, this contributed to the process of preparing students for the job market and providing them with the necessary digital skills, in addition to the skills of self-learning, and active learning, which enabled them to make optimal use of educational resources, which in turn worked to enhance the quality of education and make it more enjoyable for students and appropriate to their requirements and needs (Al-Khoulani, 2021). And since the educational process is experiencing a transitional phase that combines a tech-free past and an advanced future full of innovations in the world of Information and Communication Technology (ICT), this kind of development in modern technology has contributed to creating an informational and technical character in life, which has become one of the most prominent features and trends of the future in the twenty-first century. (Das, 2019).

IoT technology is one of the modern and multiple technological trends that differ from other old technologies and innovations as it is available at every time and place, and has the ability to include sensors in any object and obtain a special unique address. This contributed to transforming things into intelligent devices, which bridged the gaps between the physical and machine worlds; in addition, this technology will take the development of smart things to a level where the boundary between physical things and digital information is blurred because of their interrelationship, which facilitated their smart use in education, and also enhanced the level of academic processes (Shah, Mahar, Hussain, & Rehman, 2021).

IoT technology is also one of the modern technologies that has brought about a great technological and revolutionary leap in the world of the Internet and communications, so that devices and machines connected through Internet networks have become one of the most important sources in obtaining necessary information instead of people, and through this technology, a large number of devices can be merged, such as computers and advanced systems such as cars, with the World Wide Web, which allows them to exchange information and communicate through some special protocols, so that everyone benefits from this process and is able to enter different sites and search for information. (Salman & Al-Baltah 2021).

It is worth noting that the concept of IoT technology has other synonyms, such as the Internet of Value. This is because the main objective of communication, linking and understanding between things in various fields is to enhance the value of the services and products provided and develop them in a qualitative manner (Hussain and Hussein, 2021). IoT technology provides a huge amount of important information, as it consists of sensors, standard devices and wearable devices in addition to software and protocols that control things remotely through existing network infrastructures, which contributes to creating more

opportunities for the integration of the physical world into computer systems. Thus, IoT technology is enhanced by these devices and motors, making it a unique and advanced electronic system consisting of modern technologies such as smart education (Franciti, Balogh, Reichel, Magdin, Koprda & Molnár, 2020).

The researchers noticed that previous definitions share several factors, such as: linking things with sensors via the Internet, and then the processes of collecting and sending data, and later processing it, and reaching creative and smart solutions. Hence, IoT technology has evolved to become the Internet of Everything (IoE), in which the circle of integration expands to include everything. Moreover, IoT technology is a system in which the digital world interacts with the physical world using a large number of sensors and motors where computing and networking capabilities are embedded in any kind of thing and these capabilities are used to complete many educational tasks such as taking attendances and absences of students.

Kumar et al. (2022) stated that it is expected that the base of connected IoT technology devices will reach one trillion devices around the world by the year (2025 AD), while Saadia (2021) added that, in the near future, this will lead to the creation of trillions of data almost every hour, as the Internet is not only limited to computers and smart phones, but now all objects are directly and daily connected to the Internet, as IoT has no limits. Soon, people will use the Internet of Everything (IoE) instead of the Internet of Things (IoT) (Bakla, 2019). Accordingly, the researchers believe that in addition to the Internet, the spread of smart phones and smart mobile devices is the basic and most effective building block for the expansion and spread of IoT technology in the world as a whole, and in educational processes in particular, as importing or even manufacturing these devices has become easier than ever before thanks to technological openness and development.

Through a search in the intellectual literature available in various databases and search engines which presented a set of previous studies (Arabic and Foreign), and which dealt with the current topic of the study from multiple angles, researchers referred to them to enrich the discussions of this study, and some of these studies were presented as follows:

The study of Kenawy (2021), which discussed the topic of IoT technology applications in Egyptian libraries during an analytical reading to build a future vision. The study also sought to shed light on the subject of IoT technology in Egyptian libraries to develop their services, and to identify the reality of the uses of IoT technology applications in the library environment. It applied the descriptive analytical approach, after designing a questionnaire tool to obtain information. Its sample was formed from various types of libraries (academic, public, specialized, national) in the year (2017-2018) with a total of (6) libraries and their (521) qualified workers. The results showed that the most important challenges facing workers during the application of IoT technology is the lack of awareness of IoT technology applications, which came in the first place with a rate of (44.9%), while the financial problems came in the second place with a rate of (30.1%). They also showed that the future trends of IoT technology indicate the connection of millions of computers by the year 2020 (AD).

Al-Qahtani and Al-Dayl (2021) prepared a study aimed at identifying the level of conceptual awareness of the applications of Artificial Intelligence (AI) in education among students of Princess Nourah bint Abdul Rahman University, in addition to identifying the attitude towards the use of AI applications in education in the Kingdom of Saudi Arabia. The sample consisted of (333) students from various faculties during the year (2019 AD), the descriptive analytical approach was used, and the questionnaire tool was designed. The results showed that the students from all these faculties have a high degree of conceptual awareness of AI, and that the students use AI applications to a large extent in education. They also indicated that there is a statistically significant difference of (5%) for scientific faculties in terms of students' awareness of artificial intelligence and its related applications, and the results showed that students reported a positive attitude regarding the use of AI and applications in learning to a high degree.

The study of Mahmoud, Ali, and Musa (2021), which sought to determine the use of the parameters of IoT technology to move towards e-learning within Sudanese universities. It used the descriptive survey method, and to reach its objectives, a questionnaire tool was designed, which was distributed to a random sample consisting of (202) members representing the study community from various faculty members within Sudanese universities. It concluded that the obstacles do not affect the model, as the size of the effect was weak, amounting to (42%), which indicates the presence of other variables that have a significant and influential impact on the parameters of IoT technology. Also, they indicated that IoT technology in higher education greatly helps in linking the educational environment data, and provides many methods and tools that support and assist faculty members in order to implement valuable benefits for educational outcomes, which facilitates their work, provides students with a high degree of skills in the technical field, and maximizes the educational benefits for them. They also identified a number of challenges that could face IoT technology in the field of education, such as infrastructure and high costs.

The study of Mircea, Stoica, and Ghilic (2021) which aimed to verify the impact of IoT technology on the higher education environment, in addition to describing the role of IoT technology in creating a smart learning environment and advanced universities in the future. It also sought to describe the most prominent benefits and challenges that are associated with this technique in higher education stages; furthermore, it suggested a theoretical model that relied on a set of hypotheses that were validated within the environment of the higher education system in Romania. It was also based on the descriptive survey method, and the questionnaire tool was applied, which was distributed to students studying at the University of Bucharest in economic studies in Romania in particular, with a total of (31) students in the first year of Master's studies, (46) students in the second year of Master's studies, (44) students in distance learning in the first year of their university studies, and (44) faculty members. Its results indicated that relying on IoT technology in higher education has a positive impact on teaching, learning, and assessment processes; in addition, it contributes significantly to the creation of interactive classrooms. It further indicated that education policies also have a significant impact on the adoption of IoT technology in universities. They also showed that there are challenges facing this field related to data security, safety, cyber attacks, malware, and infrastructure.

Study Methodology

To reach the objectives of the study and answer all questions, the descriptive survey method was adopted, as this method is considered appropriate for this type of studies (Al-Dulaimi, 2014). The research community was formed from graduate students studying in Jordanian universities (public and private), with a total of (29,520) male and female students in the academic year 2021-2022 AD. (Ministry of Higher Education and Scientific Research, 2022a). However, the sample size was limited to (439) male and female students according to the sample size table mentioned in Al-Najjar et al. (2018), and they were randomly selected. After reviewing most of the theoretical literature and a group of similar previous studies, the study questionnaire was prepared as a tool for data collection; also, the validity and reliability of all its parts were verified. The first part was the demographic and personal data of the study sample, while the second part was the study tool which consisted of (54) items distributed over four categories, which were (the 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 judged by a group of experts in the field of curricula, teaching methods, educational technology, measurement and evaluation in Jordanian universities to determine the ability of the tool to achieve the objectives of the study, as well as to make any adjustments they find 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 coefficients were 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 showed that the internal validity of all items was acceptable, since the significance level was less than (.05), except for one item (No. 2) in which the significance level was greater than (.05), which was not acceptable and therefore it was deleted from the first category. The level of significance in all categories was less than (.05), which means that the validity level of the tool is acceptable. Also, its stability was verified by relying on Cronbach's alpha equation, 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 these values are higher than (0.7), which is considered acceptable, and therefore the tool is suitable for use. The Statistical Package in Social Sciences (SPSS) program was also used through a set of statistical methods to present the results of the study and answer its question by using the (Independent Sample T-Test).

Results

To answer the question of the study, the arithmetic means and standard deviations were calculated for the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology in the educational process according to the variables of university classification, academic level, and faculty classification as follows:

First: University Classification

The study verified the arithmetic means and standard deviations of the responses of the study sample to the degree of awareness of graduate students in Jordanian universities of the importance of using the IoT technology according to the university classification variable. Table No. (1) showed the test results.

Table (1) T-test results for the differences between the arithmetic means for the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology according to the university classification variable

University Classification	No.	Arithmetic Mean	Standard Deviation	T-Value	Significance Level
Public	179	3.86	0.604	1.926	0.842
Private	260	3.75	0.590		

The results in table No. (1) showed that there were no statistically significant differences at the significance level ($\alpha = 0.05$) in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology due to the university classification variable depending on the T-value calculated, since it reached (1.926), and the significance level was (0.842), as these values are considered non-statistical because the value of the calculated significance level is greater than 0.05.

Second: Academic Level

The arithmetic means and standard deviations of the responses of the study sample members were calculated regarding the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology according to the academic level variable. Table No. (2) showed the results.

Table (2) T-test results for the differences between the arithmetic means for the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology according to the academic level variable

Academic Level	No.	Arithmetic Mean	Standard Deviation	T-Value	Significance Level
Master	368	3.85	0.561	4.311	0.003
Ph. D	71	3.52	0.702		

The results in Table No. (2) indicated that there are statistically significant differences at the significance level ($\alpha = 0.05$) in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology due to the academic level variable, depending on the calculated T-value. It reached (4.311), and the significance level was (0.003). These values are considered statistically significant because the value of the calculated significance level was less than (0.05), and they belong to the Master's holders because the arithmetic mean was greater.

Third: Faculty Classification

The study verified the arithmetic means and standard deviations of the responses of the study sample to the degree of awareness of graduate students in Jordanian universities of the importance of using the IoT technology according to the faculty classification variable. Table No. (3) showed the test results.

Table (3) T-test results for the differences between the arithmetic means for the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology according to the faculty classification variable

Faculty Classification	No.	Arithmetic Mean	Standard Deviation	T-Value	Significance Level
Humanities	231	3.82	0.576	1.108	0.016
Scientific	208	3.76	0.620		

The results in Table No. (3) indicated that there are statistically significant differences at the significance level ($\alpha = 0.05$) in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology due to the faculty level variable, depending on the calculated T-value, as it reached (1.108) with a significance level of (0.016). These values are considered statistically significant because the value of the calculated significance level was less than (0.05), and they belong to Faculties of Humanities because the arithmetic mean was greater.

Discussing the Results

The results in table (1) showed that there are no statistically significant differences due to the university classification variable. This result can be explained according to the researchers' opinion that there are no differences in the perceptions of graduate students according to the classification of public and private Jordanian universities, because all these public and private Jordanian universities are very interested in the subject of technical developments and modern technology such as IoT technology. Also, The Jordanian Ministry of Higher Education and Scientific Research is keen to employ these technologies in all stages of the educational process, as they have an impact on the quality and outcomes of education. The researchers may attribute this result to the fact that the educational systems and laws applied in public universities in Jordan are the same as those applied in private universities, and there is no significant difference between them, rather they are similar in application. Moreover, the system of graduate studies in public universities is similar to the system of graduate studies in private universities, and that public and private universities are similar in terms of the nature and methods of teaching used by faculty members, in the educational style, and in the nature of educational patterns directed towards graduate students. Thus, this led to the absence of differences in the perception and awareness of graduate students studying in universities for IoT technology, and some graduate students have little use of the university campus, its educational facilities, and its laboratories, which are related to IoT technology and AI. Also, the periods during which students stay in universities are few compared to other university stages such as undergraduate students, the number of their

lectures are few throughout the week, and they greatly rely on their personal and self-effort. There was no available study that dealt with the variable of (university classification) as far as the researchers know.

As for the academic level, the results in Table (2) showed that there were statistically significant differences at the significance level ($\alpha = 0.05$) in the degree of awareness of graduate students in Jordanian universities of the importance of using IoT technology due to the academic level variable and in favor of the master. The researchers explain this result because the nature of the study of graduate students who hold a master's degree is generally an investigative nature that makes them turn to research and investigation methods and the use of modern technology in all their research and scientific duties and when preparing for their university thesis, which makes these students connected to technologies and technological developments, including IoT technology and AI. These technologies became at the heart of most scientific and humanitarian disciplines in various Jordanian universities. On the other hand, the nature of the study of doctoral students from postgraduate studies is of a more specialized nature than other stages of university life, which requires less specialization in the fields of technology and IoT technology from students, as they don't have to search broad topics which are not related to the topics of their specializations. Therefore, the degree of awareness of IoT technology of Master's students was higher compared to doctoral students. This result was due to the fact that the nature of students registered in the Master's level differs from the nature of the students registered in the doctoral level, and the largest percentage of Master's students is from the youth group, while the doctoral students are mostly from the older groups. So, this was reflected in the interest of Master's students to use technology more to keep pace with developments in technology, which contributes to global expansion and openness. Furthermore, doctoral students are more likely completing doctoral programs for the purposes of professional and career advancement and promotions compared to Master's students who are highly involved in scientific research and technology. All of the above, from the researchers' point of view, leads to a higher degree of awareness of Master's students regarding IoT technology in the educational process than doctoral students. There was no available study that dealt with the variable of (academic level) as far as the researchers know.

As for the faculty classification, the results in table (3) indicated that there are statistically significant differences due to this result to the variable of faculty classification in favor of the humanities faculties. This result can be explained from the researchers' point of view that most graduate students in humanities faculties resort to the application of modern technologies, AI, and IoT technology more effectively than scientific faculties of a specialized nature. In addition, the nature of students of humanities faculties is that they usually focus on and search for technological developments in their work and seek to harness all that is new in technology in the service of humanity, and work to employ them in a suitable way in most of their work to solve the problems they face. Also, the role of humanities faculties was also evident in the process of training students to formulate questions in new ways that would help them find creative and innovative solutions after relying on and using advanced technology and IoT technology. The humanities faculties also support students and provide them

with many technological skills to keep pace with the job market. They are also keen on training them in interpreting information, and evaluating its reliability and authenticity by dealing with multimedia, texts, documents, and images obtained from the use of IoT technology. All this led to the fact that these humanities faculties have a good position in the smart digital world, and for the students of these faculties to have a higher degree of awareness than the students of scientific faculties regarding the IoT technology. This result differs with the study of Al-Qahtani and Al-Dayl (2021), which showed statistically significant differences of (5%) for scientific faculties in terms of students' awareness of AI and its related applications.

Recommendations

- The Jordanian Ministry of Higher Education and Scientific Research should reconsider the list of regulations and laws regulating the issue of modern technologies and e-learning, with the need to develop national plans that include teaching IoT technology in Jordanian universities.
- The need to develop and prepare training programs and guides that enable Jordanian university students to use and understand the nature and importance of IoT technology and how to employ it in education, under the supervision of the Ministry of Higher Education and Scientific Research, to refine and develop students' skills when dealing with IoT technology efficiently.
- The need for the Ministry of Higher Education and Scientific Research to reconsider the construction and development of educational curricula and to give opportunities to include modern university courses related to IoT technology and to include them in the study plans.
- The need to provide advanced infrastructure in universities with modern equipment, laboratories and software to improve modern educational processes for students and members of academic and administrative bodies alike in the subject of IoT technology, as well as providing universities with technical and academic teams qualified 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:

- Are related to applying the degree of awareness of the importance of using IoT technology in different learning stages to other samples, such as undergraduate students.
- Are related to a recent topic such as the Internet of Everything (IOE) to identify the degree of awareness of university students about it.
- Deal with identifying and discussing the difficulties facing graduate students from their point of view when dealing with modern technology and finding solutions for that.
- Deal with other variables than the ones identified in the current study.

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