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**THE IoT TECHNOLOGIES ACCEPTANCE IN EDUCATION
BY THE STUDENTS FROM THE ECONOMIC STUDIES IN ROMANIA**

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Abstract

The main objective of this research is to test the IoT model of acceptance technologies (the Internet of Things) among the economics students from Romania. The Internet of Things refers to the interconnection between different devices via the Internet. Through this interconnection, the communication is no longer limited to the usual “human to human” form but is complemented by a new “object-to-object” form, which has a direct impact on the company’s functions. In this context, the IoT technologies acceptance by the future economists and managers is extremely important. The study included 1,179 students from four university centers from Romania and the included factors from the acceptance of IoT technologies model (Internet of Things) were analyzed using the quantitative statistical methods in SPSS, applying a series of tests processed to highlight the research results, respectively the reliability test, the validity test, the chi-square test and the Person's correlation coefficient.

The results of the study show the existence of a positive correlation between the research variables and indicate that the students from the economic studies, are ready to accept the new technological advances in IoT and to implement them in their future jobs.

Keywords: Internet of Things (IoT), education, technology acceptance model, perceived utility, ease of use, intent to use, Romania

JEL Classification: I23, I21, L86, M20

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Introduction

In the recent years, the information and the communication technology (TIC) have become a omnipresent tool in the entities lives from different economy sectors, by stimulating the innovation in the services, by increasing the efficiency of production and by reducing the costs. In addition, the technology has influenced the organization and the business management (Attuquayefio and Addo, 2014). Such benefits have long-term effects and will continue to grow, despite the difficulties and challenges of the companies nowadays.

Among the emerging TIC applications that can have a significant economic and social impact, but also a key role in the convergence of the various technologies, the Internet of Things (IoT – the internet of things) is becoming more and more popular. The IoT is described as a network of objects that can be connected to the Internet without human interaction (Park et al., 2017) and “has the potential to change the world, just as the Internet has done, perhaps even more” (Ashton, 2009), because it mediates the communication within an organization as well as between the organization and outside it, contributing to the improvement and the efficiency of the services provided at the economy level. In addition, allowing the connection of any person at any time and from any place, this technology creates the conditions for the emergence of new services (Lu et al., 2018). In other words, the IoT allows the transition to the next level of the wireless world and offers significant improvements in critical areas such as connectivity, speed and accessibility (Uckelmann et al., 2011).

Currently, the IoT technologies are successfully used in areas such the medical services, the smart retail, the customer services, the smart homes, the smart cities, the agriculture, the environmental monitoring and the industrial internet. The education sector did not remain inert to the IT technology development. Many schools and universities have introduced the IoT technologies in the educational activities for the benefit of pupils, students, teachers and the entire educational system.

Thus, in some countries, the IoT technologies are the essential learning tools (Lyapina et al., 2019). The teachers apply them in their pedagogical processes and to monitor the students' attendance and the classroom activities (Alotaibi, 2015; Jiang, 2016). The students use them to exchange data from various resources, such as portable devices, sensors and actuators (Abed et al., 2020). In addition, many universities have incorporated the IoT technology in order to optimize campus, to save the resources, to increase the student safety and security (Nie, 2013; Asseo, 2016).

Although the IoT development generates impressive benefits, there are a series of the procedural and ethical dilemmas that may affect the confidence completely, referring to new identity, privacy, protection, safety and security. Therefore, the wide use of IoT requires acceptance from users. In the information systems field, there are different theories and models of acceptance and adoption. They were developed to understand the consumer behavioral intent by regarding adoption and using technology (Chipeva et al., 2018) and to facilitate the identification of factors that influence the technology acceptance (Davis, 1989; Venkatesh and Davis, 2000).

We are about to contribute to this debate and to analyze from all angles the situation that is currently affecting the world economy on a large scale. Our study investigates the factors that affect the IoT technologies adoption by the Romanian students from the economic studies. Given that the integration of these technologies forever changes the enterprises

functions and affects the customer satisfaction and their loyalty, it is important to underline whether the economics students are ready to accept the new IoT technological advances and to implement them in their future jobs.

To achieve the objective it has used a conceptual framework inspired by the model of technology acceptance (Technology Acceptance Model: TAM) proposed by Davis (1989), which explains the use of new technologies by adopting a causal relationship between beliefs, perceptions, attitudes, intentions and behavior. The use of conceptual framework took into account other suggestions found in the literature for improving TAM.

The content of the research is structured as follows: the first part is a review the relevant literature on the IoT technologies use and their influence on the education system. The next section presents the methodology research, followed by the analysis of the research results and the final section presents the conclusions of the work, the implications and future directions of research.

1. Review of the scientific literature

The IoT concept has its origins in the 1980s and was based on RFID (RadioFrequency Identification) technology and the sensor technology that, in the connection with the Internet, allows the identification and intelligent management of data.

It was first used by Kevin Ashton in 1999 at a conference, referring to “uniquely identifiable objects or things and their virtual representations in an internet-like structure” (Han, 2011; Uzelac, Gligoric and Krco, 2015). This deadline was formalized in 2005 when the International Telecommunication Union (ITU) introduced it in the ITU Internet report and in 2012 when Rand Europe analyzed it in a report for the European Commission.

Although there is no single definition for the IoT, it is accepted that this concept refers to a global system of computer networks interconnected to the Internet to serve billions of users worldwide. In other words, the IoT is seen as a network of connections that includes millions of private, public, academic, business and government networks that are connected to a wide range of electronic, wireless and optical network technologies. Through computers, the IoT offers the ability to collect the information in real time, which can be connected at any time and from anywhere (Falkenreck and Wagner, 2017).

Specifically, the IoT provides a number of autonomous communication functions between the objects, through the use of sensors and related connectivity components (Park et al., 2017). Each device that connects to an object could be uniquely identified and must have the ability to acquire and sometimes process data in real time without human intervention (Das and Jain, 2017). Consequently, this open and comprehensive network of intelligent objects that have the ability to self-organize, share information, data and resources, reacting and acting in front of situations and changes in the environment, facilitates the communication and transmission of information (Sula et al., 2013).

In the last decade, the IoT has become a popular topic in research, creating all the prerequisites for researchers to make a significant contribution to the knowledge development in this field. Thus, some studies have explained the IoT architecture (Uckelmann et al., 2011; Li and Wang, 2013), focused on the design and use of these technologies from the perspective of the organization or industry (Schlick et al., 2013) or explained best practices for their use (Guinard et al., 2011).

Other studies have examined the technical aspects of the IoT implementation (Shang et al., 2012), highlighting that the major challenges for these technologies accepting are the security and the privacy issues (Medaglia and Serbanati, 2010), the slow technology adoption, the interoperability issues, the implementation cost and the user perception (Evens, 2015).

The recent studies have focused on the IoT technologies acceptance from the perspective of the individual consumers, trying to identify the factors that affect IoT acceptance and to propose models for accepting this technology (Kowatsch and Maass, 2012; Li and Wang, 2013; Abu et al., 2014; Al-Momani et al., 2016).

Although the IoT development generates impressive benefits, a number of completely new procedural dilemmas arise that may affect the trust, the identity, the confidentiality, the protection, the security and the safety. Also, the ethical issues, such as the immoral policies, quite common in the business areas, can cause immense damages to the individuals, the communities and the environment (Dinu, 2008, p. 7). Therefore, widespread use of IoT requires user acceptance. In the information systems field, there are different theories and models of acceptance and adoption. They have been developed to understand the consumer behavioral intent on adoption and using technology (Chipeva et al., 2018) and to facilitate the factors identification that influence the technology acceptance (Davis, 1989; Venkatesh and Davis, 2000).

In education, it is important for the students to be able to communicate with the right person at the right time and place. For this reason, many universities have rethought the teaching and the learning process (Selinger et al., 2013), gradually moving from an exclusive model of physical knowledge transfer, in the classroom teaching system, to a model of active collaboration, transfer and communication of information via technology. According to Abed et al. (2020), the universities are supported by the internet and the adoption of the IoT allows to the students to exchange data from different resources. The students around the world have already used their portable devices and smart objects in the learning process, because these students have grown up with digital technologies such as computers, smartphones, iPods, gradually losing their relationship with the books and the newspapers (Hjenaabadi, 2017). But the influence of technology on education is not limited to the involvement of students in the learning process but also to the support provided to teachers in creating personalized content and improving student outcomes (Wellings and Levine, 2009). In addition, the IoT is present in many universities in the form of security cameras, temperature control or energy consumption tools, and access tools inside the buildings (Asseo et al., 2016).

However, there is a number of disadvantages to using IoT in the education field. Among them, there is the limitation of the extracurricular opportunities organized by the educational institution, the ordinary students with a vibrant social life on campus are feeling the lack of socialization with other colleagues in the university and beyond. For the programs that require complex practical training, the online education is not an effective option (Uygarer et al, 2017). Also, another disadvantage may be the high cost of moving to the virtual, digital campus, which can generate a series of risks related to the cyber security, the loss of information or data stored as a result of the cyber attacks (Gul et al., 2017).

In their research, O'Brien (2016) and Asseo et al. (2016) analyzed the impact of the IoT and its prospects on higher education, as well as issues regarding the generated or solved

problems /difficulties by IoT, while highlighting the importance of the security, the confidentiality and the data ownership. However, Asseo et al. (2016) appreciate that one of the biggest advantages of IoT in the educational process is the personalized interaction that the teachers can have with the students, who have the opportunity to receive the recommendations and the individual homework.

However, the use of IoT in the education sector should not be viewed only from a quantitative, physical perspective. It actually shows the universities ability to adapt to the changing needs of the future employees, of the future labor market and of the future economy.

2. Research methodology

In the present study, the research was conducted both from a descriptive perspective, thus ensuring an accurate understanding of the IoT system by questionnaire respondents, undergraduate, master and doctoral students, and from an explanatory perspective, being established the relationships between the analyzed variables (Saunders et al., 2016).

This research aims to significantly identify the factors (and their interdependence relationships) that determine the behavior of respondents in the sense of accepting or rejection of the IoT technology. Thus, in order to achieve the research objectives, the authors conducted and transmitted between October 27 and November 2, 2020, an online survey among the enrolled students at the universities from the economics and business administration area at Babeş Bolyai University in Cluj-Napoca (UBB), Alexandru Ioan Cuza University from Iaşi (UAIC), the West University from Timișoara (UVT) and the Academy of Economic Studies (ASE) from Bucharest.

The selection of the 4 university centers is largely ensuring our national representation meaning that it covers the following geographical areas: UVT – West region, ASE – Bucharest Ilfov Region, UBB – North West Region, Iasi – North East region. At the same time, inside these universities, is concentrated the largest number students from the economic studies in Romania. Knowing that the total number of students enrolled in bachelor's, master's and doctoral programs in the Social Sciences fundamental field (which includes economics students) in the academic year 2019-2020 was 68305 (ANS, 2020) the sample of 1179 is considered , in the literature (Rotariu, 1999) as a very large one and, as a result, ensures a significant representativeness.

To ensure the completeness of the answers, we have formulated a series of questions, which must be checked before sending the answers. As a consequence, all our answers were complete in terms of the questions asked, with no non-answers. The applied questionnaire had two parts. The first part included four demographic and profile questions. Table no. 1 describes the researched sample.

The demographic results of the study indicate that three out of four respondents are female, which is in line with the high share of female representatives among students enrolled in Romania in the field of university economic studies. However, the situation in Romania is atypical given that in many countries, women are underrepresented among graduates of economic studies (Goldin, 2013; Crawford et al., 2018). Most respondents are under 26 years old and are mainly enrolled in undergraduate programs (78.97%). The situation of the average ages of the respondents on each level of study is presented in table no. 2.

Table no. 1. Demographic and profile data of respondents

Variables / Characteristics	Alternative	Number of respondents	Structure %
Gender	women	902	76.51
	men	277	23.49
Age	18-20 years,	660	55.98
	21-25 years,	460	39.02
	26-35 years	35	2.97
	>35 years	24	2.04
Level of studies at which they are enrolled	Bachelor	931	78.97
	Master	224	19.00
	PhD	24	2.04
University	ASE Bucharest	755	64.04
	UBB Cluj-Napoca	130	11.03
	UAIC Iași	105	8.91
	UVT Timișoara	189	16.03
Total		1,179	100.00

Table no. 2. Distribution of respondents by level of education

Level of studies	Number of respondents	Average
Bachelor	931	20.394
Master	224	23.326
PhD	24	28.381
Grand Total	1,179	21.101

Also, more than half of the respondents are affiliated to the Academy of Economic Studies in Bucharest. This large share is justified by the fact that the Bucharest Academy of Economic Studies (ASE) has the largest number of economics students in the country. The number of respondents affiliated to the other universities varies between 189 (West University of Timișoara) and 105 (Alexandru Ioan Cuza University of Iași). These data allow us to perform a cross-sectional analysis on university centers.

The second part of the questionnaire contains five sets of questions related to IoT technologies, each statement in these questions being assigned values from 1 to 5 (1 – total disagreement, 5 – total agreement). To formulate the questions, we relied on the existing literature on the technology acceptance model (Davis, 1989; King and He, 2006; Gao and Bai, 2014; Almetere et al., 2020). Trained to use IoT technologies, they tend to believe that these products are useful and easy to use, increasing the intention to use them, and that the chances of people using these technologies are considered to increase considerably if there are facilitating conditions for their use. The inclusion factors of the IoT technology acceptance model (TAM) are presented in the table no. 3.

Table no. 3. The included factors in the IoT technologies acceptance model

Factors / domains	Description of factors / domains
The usefulness of IoT technologies in the learning process (TU) – 5 items	The measure to which a person believes that their performance will improve using a particular system (Davis, 1989).
Perception of ease in using IoT technologies in the learning process (EOU) – 4 items	The measure to which a particular system is considered to be devoid of physical and mental effort when a person uses it (Davis, 1989).

Factors / domains	Description of factors / domains
Intention to use IoT technologies in the learning process (IU) – 3 items	An individual perception of leading to a specified behavior in the future (Fishbein and Ajzen, 1975).
Facilitating conditions for the use of IoT technologies in the learning process (FC) – 3 items	The degree to which a person appreciates that the organization already has the necessary structures (technical and organizational) to support the process (Venkatesh et al., 2003).
Training for the use of IoT technologies in the learning process (UT) – 3 items	Training on the use of IoT and related information and communication technology supports users in understanding, appreciating and minimizing the difficulties arising from technological complexity. (Mudaly et al., 2013).

The model includes the determinants, moderation factors and the relationships between them. The factors with the elements associated with each variable are presented into the table no. 4.

Table no. 4. The situation of the factors with the associated elements

Factors / domains	Encoding items	Statement
The usefulness of IoT technologies in the learning process	TU1	The use of IoT technologies increases the effectiveness of learning
	TU2	IoT technologies are useful in the learning process
	TU3	Using IoT technologies allows me to accomplish my professional tasks faster
	TU4	The use of IoT technologies increases the quality of learning
	TU5	IoT technologies make learning easier
Ease of use IoT technologies in the learning process	EOU1	IoT technologies should be easy to use in the learning process
	EOU2	The interaction with IoT in the learning process should be clear and intelligible
	EOU3	Using IoT in the learning process should not require a high mental effort
	EOU4	Interaction with IoT in the learning process should be flexible
Intention to use IoT technologies in the learning process	IU1	I intend to use IoT technologies in the learning process
	IU2	I believe that in the next period I will use more and more IoT technologies in the learning process
	IU3	I would recommend other students to use IoT technologies in the learning process
Facilitating conditions for the use of IoT technologies	FC1	The support of IoT teachers encourages me to use these technologies in the learning process
	FC2	Having a user guide can enhance the knowledge and skills of using IoT technologies in the learning process
	FC3	The existence of a technical support team for cases where I encounter difficulties in using IoT technologies encourages me to use these technologies
Training in the use of IoT technologies	UT1	Organizing training courses for the use of IoT technologies would encourage me to use these technologies more in the learning process
	UT2	Organizing training courses on computer systems would encourage me to use IoT technologies more in the learning process
	UT3	The existence of materials on IoT technologies improves my skills in using these technologies

Once we have defined the factors / domains and their associated elements, it is important to investigate how these factors relate to our research model on testing the acceptance model of IoT (Internet of Things) technologies among economics students in Romania. For this purpose, we used the hypothesis testing methodology to clarify the relationships / interdependence between factors, the connection between two factors being illustrated with the terms positive / negative. Table no. 5 summarizes the research hypotheses we used in our study.

Table no. 5. Research hypotheses

Research hypotheses		Relationship
H1	There is a positive correlation between perceived utility and intention to use IoT technologies	TU and IU
H2	There is a positive correlation between ease of use and perceived usefulness of IoT	EOU and TU
H3	There is a positive correlation between ease of use and intention to use IoT technologies	EOU and IU
H4	There is a positive correlation between training and perceived utility	UT and TU
H5	There is a positive correlation between training and ease of use	UT and EOU
H6	There is a positive correlation between the facilitative conditions and the intended use	FC and IU

The data collected using the questionnaire were processed using the SPSS program, and the following tests were performed: Reliability test, Validity test, Chi-squared and Pearson's correlation correlation test.

3. Results

Reliability test

Through the reliability test the consistency of the data is calculated and determined and is achieved by applying the test method of the Cronbach's alpha coefficient (Saunders et al., 2016). Thus, this method tests the reliability of the questionnaire data. In the present research, the values of the factors of the IoT technologies acceptance model were calculated as the average of all the elements that contribute to the evaluation of this model. For example, the IoT Technologies Utility (TU) is the overall average of the elements TU1 – TU5 for all cases, using the data analysis and processing functions using SPSS software. The table no. 6 presents the results of the reliability test from the IBM SPSS tool. According to Cortina (1993), the reliability test is performed for a value of the Cronbach's alpha coefficient greater than 0.7.

Table no. 6. The situation of the reliability tests results for the factors of the IoT technologies acceptance model

Factors / domains	Element/ Item	Result Coefficient Cronbach's alpha
The usefulness of IoT technologies in the learning process	TU1, TU2, TU3, TU4, TU5	0.916 (> 0.7)
Ease of use IoT technologies in the learning process	EOU1, EOU2, EOU3, EOU4	0.812 (> 0.7)
Intention to use IoT technologies in the learning process	IU1 IU2, IU3	0.907 (> 0.7)

Factors / domains	Element/ Item	Result Coefficient Cronbach's alpha
Facilitating conditions for the use of IoT technologies	FC1, FC2, FC3	0.752 (> 0.7)
Training in the use of IoT technologies	UT1, UT2, UT3	0.922 (> 0.7)

In our study, the results of the Cronbach's alpha coefficient indicate values higher than 0.7, demonstrating that the data collected were consistent and therefore very reliable.

For ease and accuracy of interpretation of the reliability test results, the values of the alpha coefficient of internal consistency are as follows: less than 0.5 – not accepted; between 0.5-0.6 – weak; between 0.6-0.7 moderate; between 0.7-0.8 – good; between 0.8-0.9 – very good and above 0.9 – excellent (Hair et al., 2003).

Validity test

The validity test assesses “the extent to which a variable measures what it should measure” (Samouel et al., 2015). The objective of using this research tool is to test the correlation between the identified factors and the intensity attributed to this correlation. In this study, the validity test was performed for each element of the IoT technology acceptance model, using *the analyse_dimension_reduction_factor function* within SPSS. Table no. 7 presents the situation of the results of the analysis of validity tests.

Table no. 7. Validity test results

Element	Validity item loading	Initial Eigenvalue		Mean	Std Dev	Result
		No. of significant extracted factors	% of variance by extracted factor			
TU1	.895	1	74.884	3.69	1.097	Item questions are valid
TU2	.834			4.03	.996	
TU3	.802			4.08	.989	
TU4	.895			3.51	1.166	
TU5	.896			3.56	1.158	
EOU1	.818	1	65.816	4.44	.843	Item questions are valid
EOU2	.861			4.56	.794	
EOU3	.700			4.05	1.053	
EOU4	.856			4.43	.839	
IU1	.927	1	84.437	3.98	.974	Item questions are valid
IU2	.914			4.08	.999	
IU3	.916			3.84	1.084	
FC1	.728	1	68.162	3.66	1.123	Item questions are valid
FC2	.884			4.21	.940	
FC3	.856			4.29	.934	
UT1	.939	1	86.575	4.02	1.026	Item questions are valid
UT2	.945			4.04	1.008	
UT3	.907			4.20	.959	

Thus, the validity test results demonstrated the validity of the questions regarding the way in which IoT technologies are perceived and accepted by the students from the economic studies within the bachelor, master and PhD programs in the university centers from Bucharest, Timișoara, Iași and Clu- Napoca.

Chi-square test

The Chi-square test is used to determine the probability that the two variables are independent. In other words, Chi-square tests whether two variables are associated and whether this association is significant (Saunders et al., 2016). A significance threshold of 0.05 is considered to indicate that there is a five percent chance that the data collected will appear only by chance.

The mean values, the totals, the standard deviations, the minimum and maximum values of each element were calculated for each case, being presented in table no. 7.

The newly calculated values were then tested according to the designed hypotheses. In IBM SPSS, *the analytical descriptive statistics crosstabs function* was used. Into the table no. 8 are presented the results of the Chi-square test, demonstrating that the factors selected from the IoT technology acceptance model are associated and this association is significant at Asimp. Sig. <0.01.

Table no. 8. The situation of chi-square test results

Association test	Chi square value	Asymptotic significance	Result
TU*IU	1.511	0.000 <0.01	The association is significant
EOU*TU	1.096	0.000 <0.01	The association is significant
EOU*IU	1.135	0.000 <0.01	The association is significant
UT*TU	932	0.000 <0.01	The association is significant
UT*EOU	1.362	0.000 <0.01	The association is significant
FC*IU	1.251	0.000 <0.01	The association is significant

Thus, the results of the analysis by the chi-square test method demonstrate the existence of a significant probability of correlation between the variables of the model of acceptance of IoT technologies.

The demographic and profile variables of the respondents allow us to deepen the study and to perform a cross-sectional analysis according to the characteristics: gender, age, level of education and university. In this sense, in order to show the difference of the respondents' perception according to the listed characteristics, in this article it was analyzed successively for each factor the testing of the hypothesis regarding the difference of two averages $H_0: \mu_1 = \mu_2$ $H_1: \mu_1 \neq \mu_2$ (z-test: Two Sample for Means) thus:

- on testing the difference in perception of female and male responses to the factors: *The usefulness of IoT technologies in learning (TU), the perception of the ease of use of IoT technologies in learning (EOU), the intention to use IoT technologies in learning (IU) and the Facilitating Conditions for the use of IoT technologies in learning (FC)* resulted in a p-value <0.05 respectively, the calculated statistical value $z = 1.966$ is higher than critical z in both types of tests. Consequently, we cannot reject H_0 , as a result, the difference

between the opinions of the respondents of the two genders is insignificant at a significance threshold of 95%. While, in the case of the factor “*Training for the use of IoT technologies in the learning process (UT)*”, the alternative hypothesis is confirmed regarding the fact that the female gender considers the training in the learning process to be much more necessary than the male gender. The results of the statistical processing are presented into the table no. 9 and table no. 10.

Table no. 9. The averages of the analyzed factors according to the gender characteristic

Gender	No. resp.	Average of TU	Average of EOU
Women	902	3.7541	4.3800
Men	277	3.8440	4.3439
Grand Total	1179	3.7752	4.3715

Table no. 10. z-test: Two sample for means Training for the use of IoT technologies in the learning process (UT)

	women	men
Mean	4.114190	3.98315
Known Variance	0.8242	0.9763
Observations	902	277
Hypothesized Mean Difference	0	
z	1.966929	
P(Z<=z) one-tail	0.024596	
z Critical one-tail	1.644854	
P(Z<=z) two-tail	0.049191	
z Critical two-tail	1.959964	

- from the comparative analysis of the respondents’ perception by age groups, the averages of the 5 factors analyzed by age groups (under 25 years and over 25 years) do not show significant variations, respectively the assessments are uniform. The results of the statistical processing are presented in the table no. 11.

Table no. 11. Averages of the analyzed factors by the age groups

Age groups	No. resp.	Average of TU	Average of EOU	Average of IU	Average of FC	Average of UT
Under 20 years	657	3.6755	4.3543	3.8600	3.9741	4.0015
21-25 years	462	3.8732	4.3864	4.0801	4.1335	4.1674
26-30 years	20	4.2500	4.4625	4.4333	4.1500	4.1167
31-35 years	16	4.3750	4.6094	4.6667	4.7083	4.8125
36-40 years	11	3.7091	4.3182	3.7879	4.0000	4.1515
over 41 years	13	3.9231	4.3269	4.1282	4.5128	4.2308
Grand Total	1179	3.7752	4.3715	3.9692	4.0557	4.0834

- from the comparative analysis of the respondents perception on study levels, in which p-value <0.05 respectively, the value of $z_{calc} < -z_{\alpha}$ statistics in the left unilateral test, significant differences between respondents averages are found in the factors: “*The usefulness of IoT technologies in the process Learning (TU), Intention to Use IoT Technologies in Learning (IU), Facilitating Conditions for the Use of IoT Technologies in Learning (CF), and Training for the Use of IoT Technologies in Learning (UT)* in which

students' opinion enrolled in the bachelor degree, differs significantly from those in the master and PhD studies. The only factor in which the null hypothesis is not rejected, respectively where there are no significant differences between age groups is related to "Perception of the ease of use of IoT technologies in the learning process (EOU)". The results of the statistical processing are presented in the table no. 12.

Table no. 12. The averages of the analyzed factors according to the level of studies

Level of studies	No. of resp.	Average of TU	Average of EOU	Average of IU	Average of FC	Average of UT
Bachelor	931	4.3048	4.3502	3.9026	4.0054	4.0340
Master	227	3.7012	4.4515	4.2115	4.2291	4.2658
PhD	21	4.0300	4.4524	4.3016	4.4127	4.3016
Grand Total	1179	3.7752	4.3715	3.9692	4.0557	4.0834

The undergraduate students appreciate the listed factors with less intensity than master and PhD students. The results of the statistical processing are presented into the tables no. 13 and 14.

Table no. 13. z-test: Two sample for means

	<i>The usefulness of IoT technologies in the learning process (TU)</i>		<i>Intention to use IoT technologies in the learning process (IU)</i>	
	Bachelor	Master and PhD	Bachelor	Master and PhD
Mean	3.46938776	3.9233871	3.76047261	4.14112903
Known Variance	1.3783	1.04268	1.203855	0.95571
Observations	931	248	931	248
Hypothesized Mean Difference	0		0	
z	-6.0213989		-5.3059941	
P(Z<=z) one-tail	8.6458		5.603	
z Critical one-tail	1.64485363		1.64485363	
P(Z<=z) two-tail	1.7292		1.1206	
z Critical two-tail	1.95996398		1.95996398	

Table no. 14. z-test: Two sample for means

	<i>Facilitating conditions for the use of IoT technologies in the learning process (FC)</i>		<i>Training for the use of IoT technologies in the learning process (UT)</i>	
	Bachelor	Master and PhD	Bachelor	Master and PhD
Mean	4.24919441	4.43548387	4.1471536	4.375
Known Variance	0.9098	0.70837	0.936387	0.81831
Observations	931	248	931	248
Hypothesized Mean Difference	0		0	
z	-3.0087574		-3.4724359	
P(Z<=z) one-tail	0.00131159		0.00025788	
z Critical one-tail	1.64485363		1.64485363	
P(Z<=z) two-tail	0.00262318		0.00051576	
z Critical two-tail	1.95996398		1.95996398	

• from the comparative analysis and testing the hypothesis of the difference in the perception of respondents by university centers resulted in all cases $p\text{-value} > 0.05$ at a significance threshold of 95%, therefore, the H_0 hypothesis cannot be rejected, there are no significant differences in students' perception in different university centers. The results of the statistical processing are presented into the table no. 15.

Table no. 15. The averages of the analyzed factors by university centers

University	No of resp.	Average of TU	Average of EOU	Average of IU	Average of FC	Average of UT
ASE – Bucharest	753	3.7578	4.3825	3.9602	4.0416	4.1040
UBB – Cluj-Napoca	125	3.9856	4.3500	4.1120	4.0907	4.1173
UAIC – Iași	110	3.6418	4.3568	3.8848	4.0364	4.0758
UVT – Timișoara	191	3.7832	4.3508	3.9599	4.0995	3.9843
Total	1179	3.7752	4.3715	3.9692	4.0557	4.0834

It turns out that regardless of the age and the university center where the students are trained, the perception of respondents accepting IoT (Internet of Things) technologies among economics students in Romania was similar.

Pearson correlation test

A very strong relationship refers to the high probability of a strong correlation between variables (Samouel et al., 2015). This relationship, as noticed so far, can only be positive or negative. A positive relationship offers the high probability that, in the situation where one variable registers a change in the direction of increase or decrease and the other variable will change accordingly, not necessarily in a linear sense (Saunders et al., 2016). Thus, the Pearson correlation test determines the extent to which the increase or decrease in the factors used in the model results in a change (increase or decrease) in another factor with which it is correlated.

Using SPSS software, factors presented in table no. 3 were processed, using the function `analyze correlate bivariate correlations`, determining the values of the Pearson's correlations coefficient for each variable. Along with the values of the correlation coefficients, the values of the significance threshold (Sig) are also presented, correspondingly. The results of the Pearson's correlation test are presented in table no. 16.

Table no. 16. The situation of Pearson's correlation coefficient

	TU	EOU	IU	FC	UT
TU	1				
EOU	0.4182	1			
IU	0.7290	0.4842	1		
FC	0.5728	0.5121	0.6125	1	
UT	0.4496	0.4708	0.4971	0.6182	1

The Pearson correlation coefficient shows the meaning of the relationship between the variables, being able to take values between -1 and +1. If it has a value of zero or close to zero, then there is no connection between the variables. The plus sign shows a direct link (as the values of variable X increase, so do the values of variable Y), and the minus sign

shows an inverse link (as the values of variable X increase, the values of variable Y decrease). The interpretation of this coefficient on 5 intervals is as follows:

- $r \in [0; 0.2]$ → very weak correlation;
- $r \in [0.2; 0.4]$ → weak correlation;
- $r \in [0.4; 0.6]$ → reasonable correlation;
- $r \in [0.6; 0.8]$ → high correlation;
- $r \in [0.8; 1]$ → very high correlation → very close relationship between variables.

Thus, according to the results of the Pearson correlation test, it can be seen the existence of a reasonable correlation between the variables TU and EOU, FC and UT – the Pearson correlation coefficient recording values between 0.4 and 0.6, and a high correlation between the variables TU and IU, IU and FC, respectively FC and UT, cases in which the Pearson correlation coefficient registers a value between 0.6 and 0.8

The research hypotheses tested were the following:

H1: Is there a positive correlation between perceived utility and intention to use IoT technologies?

H2: Is there a positive correlation between ease of use and perceived usefulness of IoT?

H3: Is there a positive correlation between ease of use and intention to use IoT technologies?

H4: Is there a positive correlation between training and perceived utility?

H5: Is there a positive correlation between training and ease of use?

H6: There is a positive correlation between the facilitative conditions and the intended use

All these hypotheses were tested and accepted, the results of these tests being summarized into the table no. 17.

Table no. 17. The situation of the test results of the formulated hypotheses

Hypotheses	Pearson's correlation	P-value	SPSS results
H1: TU → IU	0.729	$p < 0.01$	Hypothesis accepted
H2: EOU → TU	0.4182	$p < 0.01$	Hypothesis accepted
H3: EOU → IU	0.4842	$p < 0.01$	Hypothesis accepted
H4: UT → TU	0.4496	$p < 0.01$	Hypothesis accepted
H5: UT → EOU	0.771	$p < 0.01$	Hypothesis accepted
H6: FC → IU	0.612	$p < 0.01$	Hypothesis accepted

Conclusions

The main purpose of this research is to test the model of acceptance of IoT (Internet of Things) technologies among students from the economic studies in Romania. To do so, we have conducted an online survey among students enrolled in universities with a profile in economics and business administration from four universities representing the economic

field in Romania, considered regional leaders. The results of the study demonstrate the existence of a positive correlation between research variables and indicate that economics students are ready to accept new technological advances in IoT and implement them in their future jobs.

Thus, by testing the factors included in the acceptance model of the IoT technologies used, through the SPSS software (Reliability test, Validity test, Chi-squared and Pearson's correlation test) the research objectives were met by demonstrating that when people are trained to use IoT technologies, they tend to believe that these products are useful and easy to use, increasing the intention to use them. In addition, the chances of people using these technologies are considered to increase considerably if there are facilitating conditions for their use, factors that have become increasingly important in the workforce, in the context of digitalisation and online activities amid the current pandemic of disease. with SARSCo V-2 virus.

However, the research has limitations determined primarily by the age distribution of survey respondents, most of whom (95%) are between 18 and 25 years old, students in economic higher education, bachelor or master degree, they are much more open in the use of IoT technologies. Despite these limitations, we appreciate that this work is a challenge for future research in the use of IoT technologies, the challenges posed by their increasing use in the economic field, by expanding research on the degree of acceptance of IoT technologies by professionals within this segment of activity, respectively economists, experts, auditors, managers, research that can be an important source of information and reflection for practitioners and not only.

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