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Important Considerations for Future Educators Implementing IoT in the Classroom

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Abstract—

The study's overarching goal was to learn what factors could influence aspiring teachers to use IoT as a pedagogical tool. utilizing the TAM, researchers analyzed how pre-service teachers felt about the Internet of Things (IoT), how they felt about utilizing it in the classroom, and how those feelings affected their students' behavior. Forty-seven participants, all in their last year of pre-service teacher education, were selected using a random number generator. Quantitative regression analysis was used to examine the data. The results suggest that pre-service teachers' opinions about deploying IoT in classrooms were significantly influenced by TAM-related factors such the perceived usefulness and ease of use of IoT. But their outlook on the IoT didn't affect their propensity to actually use it. Participants' perceptions of the IoT's usefulness were the most important factor in shaping their intentions to adopt or continue using the technology in the future. Many future-of-education-in-the-classroom pedagogical implications are therefore discussed. Several suggestions for further study are provided as a result of this investigation.

Keywords—

E-learning, in-service teachers, the IoT, and the Technology Acceptance Model are all essential factors..

Introduction

The Internet of Things (IoT) is state-of-the-art Internet connectivity that bridges the gap between the digital and physical worlds [1]. In only a few short years, the proliferation of IoT devices has had far-reaching consequences for billions of people across all aspects of life [2]. According to the Global Standards Initiative on the Internet of Things [3], "the worldwide infrastructure for the information society that may permit joining all kinds of items, including physical and virtual things based on the provided communications protocols and technologies" best describes IoT. (p. 914). The Internet of Things (IoT) is an automation and analytics system [4] that combines technology like as networks, sensors, big data, and artificial intelligence to create perfect service systems. The broad use of IoT facilitates daily tasks, raises living standards, and fortifies relationships between individuals, communities, and objects [5]. The Internet of Things (IoT) poses a serious threat to and fundamentally alters the digital and technical future of our children [6]. By 2025 [7], it is projected that there will be more than 75 billion IoT devices in use around the globe. Rapid advancements in IoT infrastructure are resulting in a more flexible, adaptive, and efficient educational system [3]. There is little doubt that IoT technology will change the way we educate our children. Utilizing the power of the IoT

With the help of modern technological advancements, "anytime, anywhere" education may soon become a reality, vastly improving the educational experience for students [8]. However, the Internet of Things is still in its infancy in the classroom [3], and only a small number of research have focused on this area, particularly in the context of developing countries [9]. A recent systematic review, for instance, discovered that the Internet of Things (IoT) is not widely accepted or used in the classroom. This is especially the case in less developed countries, such as Saudi Arabia. Academics now have a multitude of chances to explore the barriers to IoT's potential educational benefits, particularly in developing countries. There is a severe lack of scholarly investigation on this topic. In light of Saudi Arabia's ongoing push toward digitalization, it's crucial to quickly gauge how well-equipped, open, and enthusiastic these prospective instructors are to use technological innovations like the Internet of Things (IoT) in their classrooms. This study aims to do just that, by bridging that gap in the existing literature.

Study of the Literature

Internet of Things in the Classroom

Positive benefits on student engagement and learning [10, 14] account for the rapid adoption of IoT in the sphere of education. Both student and instructor efficiency might benefit from the use of IoT in the classroom [14, 15]. One of the greatest benefits of IoT in the classroom is that it enables educators to personalize their interactions with each student. Teachers and students alike gain by interacting more with one another and with both traditional and digital resources in the classroom [8] [11]. Therefore, IoT-based classrooms may significantly affect student and educator productivity [3]. Multiple studies have indicated that introducing IoT into the classroom boosts students' learning outcomes. The Internet of Things (IoT) was used to facilitate the teaching process and increase student academic achievement in an experiment conducted with 50 students enrolled in an engineering course [16]. They found that by linking real-world things with digital ones, the IoT paves the way for richer, more meaningful learning experiences by providing access to previously unavailable data. In [17], for instance, an IoT-based, experimental distance-learning tool for architectural design was built and released. The results suggested that using IoT devices in the classroom might improve outcomes for both students and teachers. Using an IoT-based teaching management system, [18] found a favorable effect on students' learning processes in higher education. Also, a study conducted in Thailand with 244 students and four educators [9] looked at how sensor-based IoT improves students' motivation to learn. There was a notable increase in both learning outcomes and student engagement when using sensor-based Internet of Things.

Hypothesis and theoretical foundation

The Technology Acceptance Model (TAM) is one of the most well-known theoretical frameworks for investigating people's perspectives on various forms of technology; it was first suggested by [33]. To foresee or clarify the elements that influenced an individual's use of any IT system, [33] suggested the TAM [34]. [35]. Users' behavioural desire to utilise the system is a factor in their adoption of the IT system in the TAM (Figure 1) [36]. The Technology Acceptance Model (TAM) states that user perceptions of usability and utility are the most important elements in determining whether or not a given technology application will be adopted. In contrast to the perceived ease of use, which is the degree to which a person believes that using a particular system would be free of effort, the perceived usefulness of a system refers to the degree to which a person believes that using a particular system would improve his or her job performance [33]. (p. 320). That is to say, people aren't as ready or eager to adopt new technologies if they don't like the features and functionalities of such technologies [38].

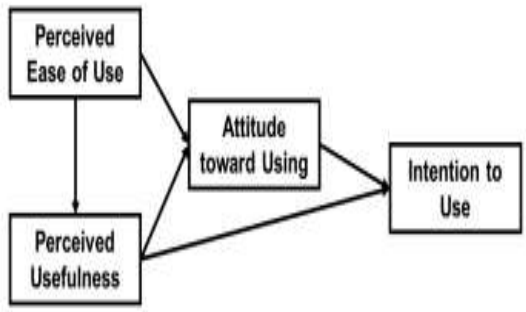

Fig. 1. The TAM [33]

Users' attitudes and intentions toward using the technology are affected by the perceived utility and convenience of use [39]. The term "attitude" is shorthand for "user's assessment on use of the system" [36]. (p. 194). TAM variables "appear to be able to account for 40 percent to 50 percent of user acceptability," as stated in [40]. (p. 152).

Methodology

In this study, we used a quantitative descriptive research methodology to investigate the TAM elements that influence pre-service teachers' decisions to utilise (adopt) the Internet of Things (IoT) in their future classrooms.

Example and background

Purposive sampling [42] was used to recruit 47 future educators, including both male and female seniors enrolled in the last year of a Bachelor of Computer Teacher programme at the School of Education's undergraduate division. The participants were enrolled in a 14-week long Instructional Software Design course and were given a series of projects that corresponded to the weekly lecture material. Students were required to choose and use a single Internet of Things (IoT) application (such as Google Lens, Goggle Assistant, etc.) for a variety of tasks, including research, reporting, and practical design experience. Direct searches (using the app's built-in search bar), translation, and reading of screen-specific content were all examples of tasks assigned to

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students (scanning a barcode or recognising text through the application). The tasks were well-aligned with the course goals of providing the students with the knowledge and abilities they will need in their future careers as educators.

Results

Cronbach's alpha was used to establish the reliability and validity of the survey items. Pearson's correlation was used to determine the strength of association between the independent and dependent variables, and descriptive statistics were provided for each. Two multiple linear regressions and the results of the basic regression followed.

Examining the truthfulness and accuracy of something

Cronbach's alpha coefficient (in the event of an item deletion) and correlation coefficients (item-total correlation) were used to determine the internal consistency between the items of each construct and hence the reliability of the survey, which consisted of four measures (variable). Table 3 shows that all item-total correlation coefficients are statistically significant (=0.01), indicating that all survey items have high levels of internal consistency and dependability. The Cronbach's alpha for the whole study's four variables (perceived ease of use, per ceiled usefulness, attitude, and intention to use) was between 0.844 to 0.893 [44]. All item correlation coefficients (adjusted item-total correlation) were statistically significant at the 0.05 level, indicating the reliability of the instrument's items.

Table 1. Reliability and validity coefficients of the survey

Constructs	Items	M (SD)	Cronbach's Alpha (if Item Deleted)	Item-Total Correlation	Corrected Item-Total Correlation	Cronbach's Alpha
Perceived ease of use (6) items	PEU1	3.99 (.69)	.796	.849*	.741*	.854
	PEU2		.817	.753*	.652*	
	PEU3		.800	.823*	.733*	
	PEU4		.813	.780*	.659*	
	PEU5		.807	.660*	.480*	
	PEU6		.803	.814*	.707*	
Perceived usefulness (6) items	PU1	3.74 (.76)	.893	.734*	.599*	.893
	PU2		.866	.844*	.774*	
	PU3		.880	.786*	.678*	
	PU4		.853	.897*	.839*	
	PU5		.869	.830*	.747*	
	PU6		.881	.765*	.667*	
Attitude toward use (4) items	AU1	3.79 (.74)	.856	.742*	.549*	.844
	AU2		.774	.864*	.744*	
	AU3		.748	.899*	.794*	
	AU4		.816	.795*	.646*	
Intention to use (3) items	IU1	3.74 (.72)	.905	.809*	.626*	.863
	IU2		.711	.937*	.837*	
	IU3		.772	.906*	.777*	

Note: *Correlation is significant at the 0.01 level.

Correlation and descriptive analysis

As shown in Table 3, the mean of four study constructs ranged from 3.74 to 3.99, demonstrating that pre-service teacher participants' perceptions of the IoT were slightly high in terms of these four factors.

Table 2. Correlations between independent and dependent variables

Hypotheses	Dependent Variable	Independent Variable	Pearson Correlation	p-Value
H1	Perceived usefulness	Perceived ease of use	.690	.000*
H2	Attitude	Perceived ease of use	.742	.000*
H3	Attitude	Perceived usefulness	.668	.000*
H4	Intention of use	Perceived usefulness	.656	.000*
H5	Intention of use	Attitude	.545	.000*

Note: *Correlation is significant at the 0.01 level.

Before regression analysis, for each hypothesis, Pearson's correlation coefficient was calculated between the dependent and independent variables. All correlations (shown in Table 4) were statistically significant and positive between every pair of variables: perceived ease of use and perceived usefulness ($r=.690$, $p<.001$).

Conclusion

In this study, researchers in Saudi Arabia looked at what motivated aspiring educators to pursue careers in education and the ways in which Internet of Things technology may be used in the classroom. As a result, we discussed and analyzed TAM factors such the perceived ease of use, usefulness, user attitude, and the hopes and dreams of future educators with regards to using IoT. Due to its apparent ease of use and value, we hypothesized that the study's pre-service teachers would acquire a positive opinion of IoT technology, boosting their degree of intention to adopt it in their future careers. Both a simple regression and two multiple linear regression analyses were performed on the participants' IoT use intentions. It was shown that pre-service teachers' favorable evaluations of the IoT's usefulness were influenced by their perceptions of the technology's ease of use.

Both the perceived usefulness and the perceived ease of use of the IoT had significant effects on attitude, with the latter aspect proving to be more significant. Perspectives on the IoT's utility significantly influenced the likelihood that future teachers would choose to use the technology in their classrooms. Although their feelings about using IoT in the classroom were a consideration, it did not significantly affect their intentions to utilize it. The findings indicated that the perceived usefulness of IoT was the most significant factor in predicting participants' intentions to deploy it in future classes, followed by the perceived ease of usage. Based on these findings, it is recommended that teacher education programs better prepare future educators to use Internet of Things (IoT) technologies in the classroom and incorporate them into their curricula and course designs.

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