

Applying the UTAUT model in Engineering Higher Education: Teacher's Technology Adoption

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Abstract — Many research theories try to explain the adoption/rejection of technology by the users. One of them focuses on the study of the acceptance and the intention of its use and it is named Unified Theory of Acceptance and Use of Technology (UTAUT). The main goal of this article is to model the verification of the adequacy of UTAUT to the use of information technologies (IT) in pedagogical processes in Higher Education (HE). A research methodology centered on the analysis of the use of the e-learning platform in the Instituto Superior de Engenharia do Porto (ISEP) has been developed in order to validate the factors in that context.

Keywords- *E-Learning platform; Higher Education; ISEP; MOODLE; UTAUT Model.*

I. INTRODUCTION

Since the 1980s, the organizations have made a great investment in the information technologies (IT) area. According to Westland and Clark [1], about half of all the investments made by companies are channeled to IT. Obviously, those investments aim an increase of productivity, hence, profit. However, to attain those objectives it is necessary that those technologies are accepted and adopted by the employees. That is also true when we refer to a school of higher education and to the use of technology by teachers in pedagogical processes.

Many studies have been developed to find explanations for the process of technology acceptance, with the aim of finding a useful tool to predict the acceptability of introducing a particular technology in an organization. That allows a better understanding of the factors that are behind that process of acceptance and, thus, it allows deciding and planning interventions, such as training and dissemination courses for staff and/or potential users, in order to eliminate or mitigate the barriers that are normally faced when adopting new technologies.

There are several lines of inquiry that seek to explain the adoption of technology by users. One line of research focuses on the study of individual acceptance of technology, by using intention and actual usage as dependent variables [2]. These researchers tested thirty-two variables of eight models - the Theory of Reasoned Action (TRA), the Technology

Acceptance Model (TAM), the Motivation Model (MM), the Theory of Planned Behavior (TPB), the Combined Model (TAM/TPB), the Model of PC Utilization (MPCU), the Innovation Diffusion Theory (IDT) and the Social Cognitive Theory (SCT) - in order to define which ones are more important on the influence of technology use. In an attempt to integrate the most important models and theories about the acceptance of ICT, Venkatesh et al [2] created the UTAUT model [3].

The aim of this paper is the attempt to present a model which checks the UTAUT model adequacy in HE. The motivation of this study relates to the fact that, despite the benefits expected from the introduction of an e-learning platform to support teaching, the acceptance of that platform by its potential users is, however, critical to its success. In this article, besides a survey of the different theories, we present a description of the verification process and some of the tools of data collection, in particular, a survey that checks the facilitating and limiting factors of the use of the platform by teachers in ISEP.

II. BASE MODELS

In this section, we briefly describe the eight models or theories underlying the UTAUT model.

A. Theory of Reasoned Action (TRA)

The TRA proposed by Fishbein and Ajzen [4,5] aims to predict the behavior of users in a given situation. Its main premise considers that users will adopt a specific behavior if they perceive that this will lead to positive results [6].

In the TRA, a person's behavior is directly influenced by their willingness to adopt or not that behavior (Present Behavioral). Behavioral Intention, on the other hand, is influenced by two factors: Attitude Toward the Behavior and Subjective Norm [3,4,5].

B. Technology Acceptance Model (TAM)

The TAM [7] was specifically designed for the area of Information Technology (IT). This model is based on theoretical and empirical components [8], and it has been successfully tested by several researchers [9,10].

The TAM has altered some of the associated measures mentioned in TRA by others related to technology acceptance: the ease and usefulness of a system [11]. The TAM indicates that the Behavioral Intention to Use, which is the willingness to use the system in the future by the user, is determined by two variables: Perceived Ease of Use and Perceived Usefulness [3,12,13].

C. Motivation Model (MM)

Motivational variables, such as promotion, management and regulation of behavior, are a core component of motivational activation process in the pedagogical intervention [13,14,15]. In fact, the recovery of intentional processes that streamline the construction of the teachers' psychosocial identity requires a broad understanding of some pre and post decisional processes underlying the functioning of personalized motivation in meaningful contexts of interaction, examples of which are the self - efficacy expectations, perceptions of barriers within the scope of socio professional performance, and personal achievements of planned actions [16-20].

The Theory of Motivation formulated by Deci [21,22,23] defends that the behavior is determined by intrinsic and extrinsic motivations. While extrinsic motivations lead to action because of its rewards, such as increased performance [24], intrinsic motivations refer to the satisfaction resulting from the practice of an action itself [25].

According to Vallerand [26], Intrinsic Motivation refers to the pleasure or value associated to an activity. On the other hand, Extrinsic Motivation values the result of an action and the likelihood of achieving it.

Vroom [25] derived from this theory, applying it to the study of the adoption and use of new IT [3,27,28].

D. Theory of Planned Behavior (TPB)

The TPB [29] is an extension of the TRA that adds the variable Perceived Behavioral Control, defined as the perception of a person on the ease or difficulty which represents the practice of a particular behavior. The Perceived Behavioral Control depends on Control Beliefs and Perceived Facilitation of that control factor to facilitate or inhibit behavior [3,29,30].

E. Combined Model TAM/TPB (TAM/TPB)

Taylor and Todd [31] introduced a hybrid model that combines the variables of the TPB with Perceived Usefulness of the TAM.

They added a variable on the user experience in IT, called Previous Experience. Taylor and Todd [31] theorized that by separating users into groups based on Previous Experience, different forces would be revealed on the effects of variables of this model. For new users, the Behavioral Intention seems to be more influenced by the Perceived Usefulness, followed by the Ease of Use. The main contribution of this combined model suggests that the experience levels of users should be considered in studies of the acceptance of IT [3].

F. Model of PC Utilization (MPCU)

The MPCU derives greatly from the Theory of Human Behavior established by Triandis [31].

Some authors [33] adapted this theory to predict the use of personal computers rather than the intention. However, its application has become adequate to predict the acceptance of a wide variety of IT [3].

G. Innovation Diffusion Theory (IDT)

IDT is a theory based on Sociology, with a strong prominence in the field of explaining the use and adoption of technology [34,35].

The concept of innovation is an idea, practice, or object that is perceived as something new for a user [36]. Innovation creates uncertainty, which motivates a user to seek information about alternatives. Diffusion is the process by which innovation is communicated through different channels over time, by the members of a social system [35]. IDT aims to explain the decision process of innovation and determine the factors that influence the rate of adoption as well as the adopter's categories. It aims to predict the probability of adoption of an innovation and its adoption rate.

One of the most important contributions of this theory is the definition of innovation decision process, which begins with the user's knowledge of an innovation and ends with the confirmation of the adoption or rejection of that innovation.

IDT emerged from the study of innovations in the 1960s [37] and has been used in various types of technologies since then [3,38].

H. Social Cognitive Theory (SCT)

SCT supports the search for answers to questions such as: How does the work and other life roles are assumed as more or less relevant? How can individuals take self-directivity in its development progress?

The Bandura's social cognitive theory [39,40] emphasizes the personal variables of self-efficacy, outcome expectations, goals and interaction with environmental variables such examples of important personal development, such as social support. These authors assume that a complex set of factors - culture, gender, socio-structure, state of health - works together and influence the cognitions, the nature and scope of skills.

As such this theory can scaffold the individual and specific behavior in relation to technology adoption.

III. UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY (UTAUT)

The UTAUT was published in September 2003 by researchers [2] in the area of technology acceptance, based on empirical and conceptual similarities of the eight models/theories exposed in the previous section.

The studies that led to its formulation empirically compared the models, using surveys with items to measure the variables in all of them, in four organizations of different industries that had set plans to introduce new systems. It is important to refer that, from the four systems, two of them were mandatory and the others were for voluntary.

They were longitudinal studies, conducted on three different occasions: after the training on the system, a month later and three months after implementing the system. The actual use of the system was measured six months after the training of users. Finally, the model was validated in two other organizations, being able to explain approximately 70% of the

variation in technology acceptance behavior, a notable increase over other models that, on average, stood at 40% [2].

The UTAUT defends that there are three variables that determine directly, significantly, the intention of using a particular system, namely: Performance Expectancy, Effort Expectancy and Social Influence. Behavioral Intention is the willingness shown by the user in using the system in the future, the Facilitating Conditions influence directly the Use Behavior, which concerns the effective use of the system. As moderators of those variants, we have Gender, Age, Experience and Voluntariness or Willingness of Use [2,3] as we can see in the graphical representation, in Figure 1, presented in by Venkatesh et al [2].

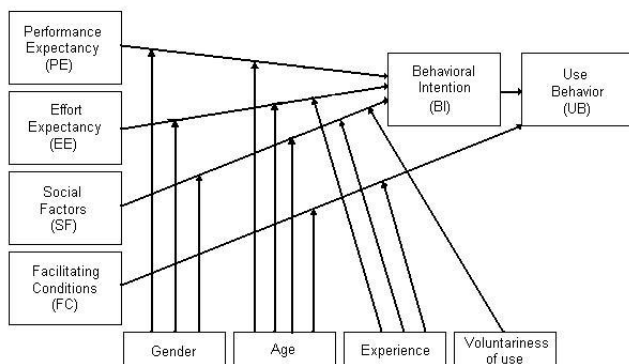


Figure 1. Graphical representation of UTAUT Model [2]

A. Performance Expectancy (PE)

Performance Expectancy is defined as the degree to which the user believes that using a particular system will improve his/her performance. This variable, independently of a voluntary or mandatory use of the system, is the strongest determinant for the prediction of behavioral intention. The relationship between Performance Expectancy and Intention to Use is moderated by Gender and Age [2].

B. Effort Expectancy (EE)

Expectation Effort refers to how easy the use of a certain system is, as perceived by the user. It is a significant variable, both within the voluntary and mandatory use of a system. The Effort Expectancy is moderated by Gender, Age and Experience in the variable of Intention to Use [2].

C. Social Influence (SI)

Social Influence is defined as the degree to which a user perceives how important it is for other people to use the system. This variable is based on the assumption that individual behavior is influenced by the way a user believes other people will look at him/her according to whether he has or has not used the technology. The moderators of Social Influence are: Experience, Gender and Age [2].

D. Facilitating Conditions (FC)

Facilitating conditions are defined as the degree to which a user believes that an organizational and technical infrastructure exist to support the system. Facilitating conditions have a direct influence on system use and are moderated by Experience and Age [2].

IV. ADEQUACY VERIFICATION OF THE MODEL UTAUT

ICT made an impact on all aspects of society over recent years, and its potential to transform education is widely mentioned. The high expectation on the role ICT can play in schools presents both opportunities and challenges for those involved in its implementation and application for teaching and learning. The pressure to use technologies for learning emerged also from the implementation of the Bologna Declaration, which aims to harmonize the structures HE and to increase the competitiveness of the European HE system.

With this study, it was intended to analyze the adoption of IT in higher education. As the authors had already understood in two case studies [41,42], the use of a particular technology, an e-learning platform, by the teachers of ISEP was far from exploring all its potential. The authors wanted to assess if the UTAUT model could provide an effective answer that explained the lack of use and, at the same time, provided clues to improve its adoption. Those observatory cases studies were based on quantitative data resulting from logs of the platform usage which however did not provide enough information to assess the validity of the UTAUT model.

Therefore the authors created a questionnaire where the main four variables of the model were considered, as well as the four moderating factors.

The questionnaire items used to measure the variable Performance Expectancy are:

- The platform is useful to my work. (Q1)
- The platform allows me to accomplish tasks more quickly. (Q2)
- The platform increases my productivity. (Q3)
- The platform increases the chances of success for students. (Q4)
- I feel apprehensive about using the platform.(Q5)

The questionnaire items used to measure the variable Effort Expectancy are:

- My interaction with the platform is clear. (Q6)
- The platform is easy to use. (Q7)
- Learning to use the platform was easy for me. (Q8)
- The platform is not compatible with other systems that I use. (Q9)
- I might finish a job or task using the platform, without anyone telling me what to do. (Q10)

The questionnaire items used to measure the variable Social Influences are:

- People who influence my behavior think I should use the platform. (Q11)
- The management of the Institution thinks that I should use the platform. (Q12)
- My colleagues believe that the platform has been helpful. (Q13)
- Students have requested support from the course on the platform. (Q14)
- The existence of e-Learning platforms in other educational institutions motivates me to use our platform. (Q15)

The questionnaire items used to measure the variable Facilitating Conditions are:

- The school has supported the use of the platform. (Q16)
- I have the knowledge to use the platform. (Q17)
- I have the resources to use the platform. (Q18)
- There is someone available to assist when difficulties arise with the platform. (Q19)
- The platform makes the work more interesting. (Q20)

The questionnaire items used for the moderator Willingness to Use are:

- The platform is not compulsory in my work. (Q21)
- The course director does not require using the platform. (Q22)
- The school board expects me to use the platform. (Q23)
- Use the platform is voluntary. (Q24)

Other moderating factors - Gender, Age and Experience - appear in the description of the participant.

V. RESULTS

Questionnaires were distributed to teachers at ISEP, based on a Lickert scale where possible answers range from 1- Strongly disagree, through 4 - Neutral (neither agree nor disagree), to 7 - I agree completely.

Results show that the average values of each factor of the UTAUT model (*Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions and Voluntariness of Use*) are between 4.94 and 5.31, as shown by the summary table - Table I.

The factor with an average value closer to neutral is *Social Influence* and the generality of those who answered the survey were closer to 4 in the questions: - People who influence my behavior think I should use the platform (Q11). - The management of the Institution thinks that I should use the platform (Q12). - My colleagues believe that the platform has been helpful (Q13). - Students have requested support from the course on the platform (Q14). - The existence of e-Learning platforms in other educational institutions motivates me to use our platform (Q15).

The most positive factor is *Facilitating Conditions*, which the persons answering the survey responded with values closer to the seven: - The school has supported the use of the platform (Q16). - I have the knowledge to use the platform (Q17). - I have the resources to use the platform. (Q18) - There is someone available to assist when difficulties arise with the platform. (Q19) - The platform makes the work more interesting. (Q20).

Table I - Overall results for factor

Factor	Average
Performance Expectation (PE)	5,24
Effort Expectancy (EE)	5,11
Social Influence (SI)	4,94
Facilitating Conditions (FC)	5,31
Voluntariness of Use (VU)	5,25

Making an analysis by gender, overall, women are more optimistic (Figure II) in the responses to the questionnaire except in the factors *Effort Expectancy (EE)*, *Facilitating Conditions (FC)* and *Voluntariness of use (VU)* (Figure III).

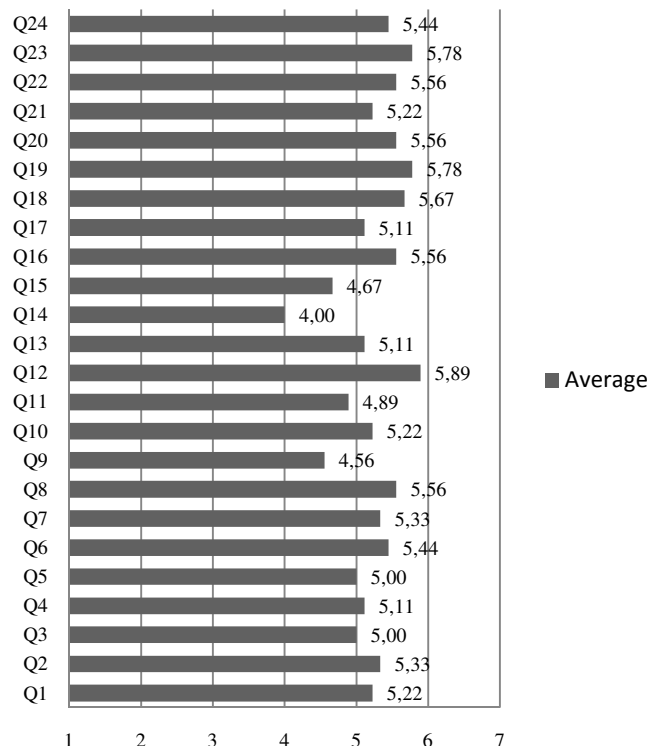


Figure II - Gender Female

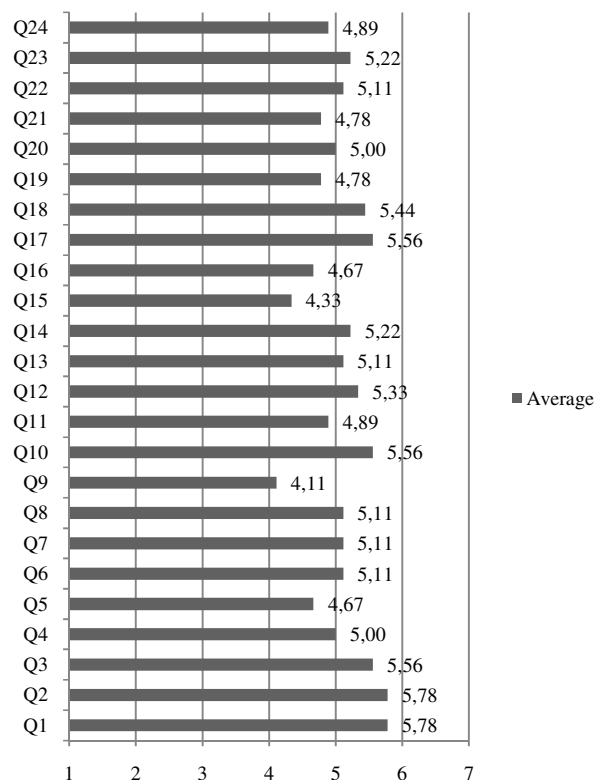


Figure III - Gender Male

Considering the *Previous training*, results were separated between those that received some training to use the platform, and those that did not. The answers given by those trained to

use the platform (Figure IV) are more optimistic on the factors *Performance Expectation (PE)*, *Facilitating Conditions (FC)* and *Voluntariness of Use (VU)* than those given by those not trained (Figure V). However it is less optimistic on the factors *Effort Expectancy (EE)* and *Social Influence (SI)*.

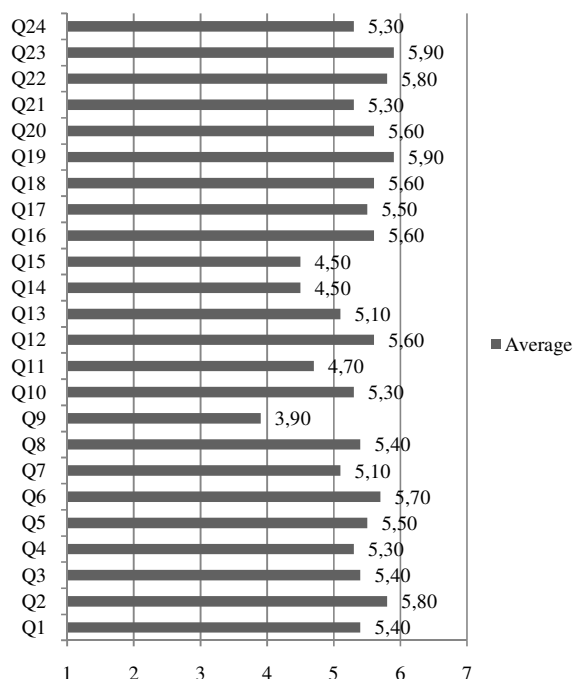


Figure IV - With platform MOODLE training

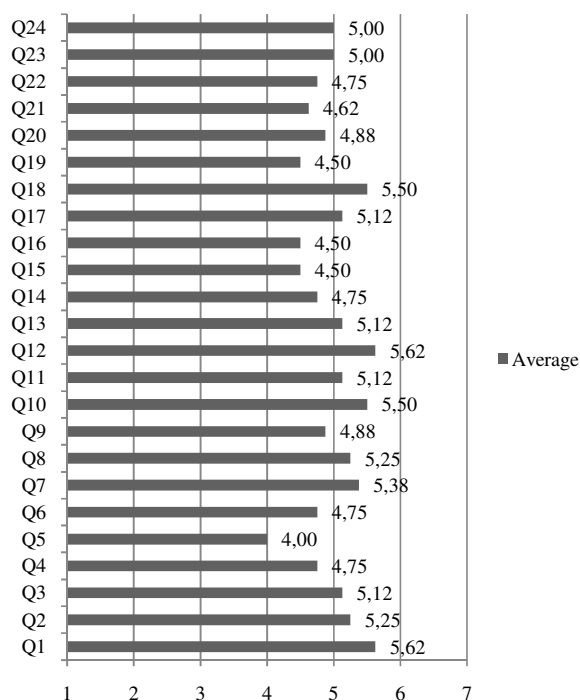


Figure V - Without platform MOODLE training

VI. CONCLUSIONS

This article is a short survey of the eight theories and/or models that originated the UTAUT model and a brief

description of that model. We also explain the reason to attempt to validate this model in an Engineering Higher Education School. We describe the methodology and the main tools that we used and will use in this process. In short, this study is meant to find solutions that lead to improved adoption of the use of technology by teachers in Higher Education more specifically at ISEP.

The answers to the questionnaire, which was done following the model UTAUT, reflect that those who replied are people that use the platform; however it does not allow us to gauge whether such use corresponds to a proper use of the platform, that is, not to be used only as a repository of information.

The five factors, Expected Performance (EP), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Voluntariness of Use (VU), obtained results above average. Enabling factors are the Facilitating Conditions (FC) and Voluntariness of Use (VU) that scored more optimistic in general observation.

In the gender separation women are more optimistic in the responses to the questionnaire, except in the factors Effort Expectancy (EE), Facilitating Conditions (FC) and Voluntariness of use (VU).

VII. FUTURE WORK

In a next step these results will be used to define a methodology to intervene near the teachers of the institution, possibly including specialized training in MOODLE modules such as: WORK, CHAT, DATABASE, FORUM, WIKI, WORKSHOP, Etc... It is intended to encourage the use of these modules in order to combat the use of the platform just as a repository and encourage its use in the context of e-learning.

ACKNOWLEDGMENT

The authors would like to thank Mrs. Cristina Costa Lobo for the support given in the review of the theories and models. We are also grateful to Sara Veiga, for the translation work, in spite of all the stress caused by short deadlines.

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