INNOVATION THEORIES IN HIGHER EDUCATION: DETERMINANTS OF PROFESSORS' BEHAVIOR IN ADOPTING TEACHING TECHNOLOGIES, METHODS AND PRACTICES

TEORIAS DE INOVAÇÃO NA EDUCAÇÃO SUPERIOR: DETERMINANTES DO COMPORTAMENTO DO PROFESSOR NA ADOÇÃO DE TECNOLOGIAS, MÉTODOS E PRÁTICAS DE ENSINO

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ABSTRACT

The professor's behavior is still an emerging issue with few quantitative studies. The choices of technologies, methodologies and teaching practices of a professor affect both professors and the learning of students, turning out to be an increasing interest in research in many areas of education. The main objective of this research is to analyze how innovation theories can be applied to identify the determinants of professor's behavior in the adoption of teaching technologies, methods and practices, seeking to identify new variables and constructs, for the development and expansion of theoretical models. This article begins with an explanation of base theories widespread in other areas of knowledge, Theory of Planned Behavior (TPB), the Innovation Diffusion Theory (IDT), the Technology of Acceptance Model (TAM) and the Decomposed Theory of Planned Behavior (DTPB), to understand the application in studies on professor's behavior. There are some researches in various courses and levels of education to illustrate the application of these theories to identify the determinants of the use of technologies, methodologies and teaching practice by professors. These theories and models can be used to predict the adoption of new technologies as a platform for e-learning, teaching methods and practices such as active learning methodologies and cross-cutting themes such as Sustainability.
Keywords*: Professor's Behavior. Theory of Planned Behavior. Innovation Diffusion Theory. Technology of Acceptance Model. Decomposed Theory of Planned Behavior.*

RESUMO

O comportamento do professor é ainda um tema incipiente com poucos estudos quantitativos. As escolhas de tecnologias, metodologias e práticas de ensino do professor afetam tanto os docentes quanto a aprendizagem dos discentes, tornando um tema de interesse crescente de pesquisas em diversas áreas da educação. O objetivo desta pesquisa é analisar como as teorias de inovação podem ser aplicadas para identificar os determinantes do comportamento do professor na adoção de tecnologias, métodos e práticas de ensino, buscando identificar novas variáveis e construtos, para o desenvolvimento e ampliação de modelos teóricos. O artigo inicia com a apresentação das teorias de bases amplamente difundidas em outras áreas do conhecimento: a

Teoria do Comportamento Planejado (TPB); a Teoria da Difusão da Inovação (IDT); o Modelo de Aceitação da Tecnologia (TAM); e a Teoria do Comportamento Planejado Decomposto (DTPB), para o entendimento da aplicação em estudos sobre o comportamento do professor. Na sequência, são apresentados alguns estudos quantitativos realizados em diversos países, cursos e níveis de ensino, para ilustrar essa aplicação. Estas teorias e modelos podem ser usados para se prever a adoção de novas tecnologias como uma plataforma de educação à distância, métodos e práticas de ensino como as metodologias ativas de ensino e temas transversais como a Sustentabilidade.

Palavras-Chave: Comportamento do Professor. Teoria do Comportamento Planejado. Teoria da Difusão da Inovação. Modelo de Aceitação de Tecnologia. Teoria do Comportamento Planejado Decomposto.

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INTRODUCTION

Studies published in the area of teaching, research and administration are predominantly qualitative in Brazil. The maturity indicator, for some areas of knowledge, is the predominance of the quantitative approach, or, evidence of growth of this type of research may explain the fact that a field of knowledge becomes more consolidated. Among the themes investigated in this area, teacher behavior is still incipient and there are few quantitative studies. Adoption of professor's teaching technologies, methodologies and practices affect both professors and student learning, making it a topic of growing interest in research in various areas of education.

Given the limitations of theories in explaining teacher behavior, regarding the adoption of technology, methodologies and teaching practices in their disciplines, the research uses models from the social psychology area, expanding analysis variables from seminal models. This implies the development of more appropriate and coherent structures for understanding teacher behavior in the field of business teaching and research as part of subsequent empirical work.

Thus, to investigate the determinant factors of adoption, we searched for theories already consolidated and that include behavioral analyzes. These models, whose theories are already established in several areas, namely the Theory of Planned Behavior - TPB (AJZEN; FISHBEIN, 1972, FISHBEIN; AJZEN, 1975, AJZEN, 1985, 1991 and 2001), the Innovation Diffusion Theory - IDT (ROGERS, 1983), the Technology of Acceptance Model - TAM (DAVIS, 1989) and the Decomposed Theory of Planned Behavior - DTPB (TAYLOR; TODD, 1995). Among these studies, it is highlighted the analyzes on consumer behavior (CHEN; LU, 2011) and technology adoption behavior (JALIVAND; SAMIEI, 2012; AWA; OJIABO; EMECHETA, 2015; BAKER; AL-GAHTANI; HUBONA, 2007; JOLAEE et al., 2014).

In education, several studies using TPB, IDT, TAM and DTPB were developed to explain the adoption of methodologies, professors' teaching technologies and practices, such as professors' adoption of the computer for classroom teaching (TONDEUR et al., 2008; LEE; CERRETO; LEE, 2010), the adoption of technological tools in teaching (AJJAN; HARTS-

HORNE, 2008); the adoption of a technological innovation as the virtual platform by professors and administrators in the field of education (HUSSEIN; MOURAD, 2014), professors' self-efficacy as a determinant of positive educational outcomes (HOLZBERGER; PHILIPP; KUNTER, 2013), the adoption of professors' knowledge for their professional practices (FIVES; BUEHL, 2014), teaching practice of professors in Education and Environment (SHUMAN; HAM, 1997), analysis of environmental sustainability issues in the school curriculum (KALU; UWATT; ASIM, 2004), the adoption of new teaching skills (USHER; PAJARES, 2008) and the adoption of innovative professor behavior for teaching (THURLINGS; EVERS; VERMEULEN, 2015).

Processes that innovate curriculum as well as teaching and learning experiences, imply a broader meaning, a change of mindset, in which social assumptions and dominant forms of thinking are questioned (TILLMANNS et al., 2014). The Directive Committee of the United Nations Economic Commission for Europe - UNECE recently provided some guidelines on education for sustainable development for all educators to establish their professional development on the topic, because they believe these educators can become the main agents of change if they feel capable and supported in their effort (PIPERE; MICULE, 2014).

This article aims to analyze professors' behavior in the adoption of teaching technologies, methods and practices, seeking to identify new variables and constructs for the development and expansion of quantitative theoretical models; therefore, some quantitative studies are presented in several countries, to illustrate research on professor behavior in high impact journals in education, that use base theories widely spread in other areas of knowledge such as TPB, IDT, TAM and the DTPB.

This paper begins by explaining the seminal models of the Theory of Planned Behavior, the Innovation Diffusion Theory, the Technology of Acceptance Model and the Decomposed Theory of Planned Behavior, for understanding the application in studies on teacher behavior. Below we present some research in various courses and levels of education to illustrate the application of these theories in identifying the determinants of technology adoption, teaching methodologies and practice by professors.

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THEORETICAL MODELS OF ADOPTION

The aim of this paper is to examine how some theories, which are often used to investigate the adoption of innovations, can also be applied in the area of education to investigate the adoption of technologies, methodologies, practices and teaching topics in Business Management. As will be seen later, these theories (Table 1) have already been successfully applied in education.

Table 1 Reference framework of the theories and their authors

AUTHOR/YEAR	SUPPORT THEORY
Fishbein and Ajzen (1975)	Theory of Reasoned Action (TRA)
Ajzen (1991)	Theory of Planned Behavior (TPB)
Rogers (1983)	Innovation Diffusion Theory (IDT).
Davis (1989)	Technology Acceptance Model (TAM).
Taylor and Todd (1995)	Decomposed Planned Behavior Theory (DTPB)

Source: Authors.

Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA), proposed by Fishbein & Ajzen (1975), is probably one of the most widely used theories in explaining human behavior. According to this theory, the intention to manifest behavior can be explained from the attitude towards behavior and subjective norms. The attitude toward the behavior is defined as the feelings, whether positive or negative, of an individual in relation to the adoption of a target behavior (FISHBEIN; AJZEN, 1975). Subjective norms, in turn, refer to the perceptions of an individual regarding the people who are important to the said individual think about his/her adoption of target behavior (FISHBEIN; AJZEN, 1975). In other words, subjective norms reflect the perception of other people's opinions about the adoption of a specific conduct by the individual. According to TRA, the more positive attitudes toward behavior and the stronger the subjective norms, more likely that an individual will

adopt a target behavior. Thus, for example, if a professor has a positive attitude toward adopting active learning methodologies and imagines that their peers, their coordinator, the school principal and their students believe they should adopt active learning methodologies, the greater the probability that said professor will adopt active learning methodologies in their classes.

Theory of Planned Behavior (TPB)

Theory of Planned Behavior (TPB) was prosposed by Ajzen (1985) as an extension of the Theory of Reasoned Action (FISHBEIN; AJZEN, 1975) for situations where individuals do not have complete control over their behaviors. In general terms, TPB adds perceived behavioral control to TRA. Perceived behavioral control is the extent to which the individual perceives that there are internal or external barriers to adopting a target behavior. In other words, this construct reflects the ease or difficulty of adopting a particular behavior (Ajzen, 1985).

In TPB, the adoption of target behavior depends on behavioral intention and perceived behavioral control (Figure 1). Behavioral intention, in turn, depends so much on attitude toward behavior, subjective norms, and perceived behavioral control. Returning to the example of adopting active learning methodologies, if a professor imagines that they are unable to teach using active learning methodologies or if they realize that the school in which they teach will not support their initiative, the lower the probability they will adopt active learning methodologies in their classes.

Figure 1 Relationship between TPB constructs

Source: based in Ajzen (1991, p. 182)

Innovation Diffusion Theory (IDT)

The Innovation Diffusion Theory has been used since the 1960s to explain the process of adopting innovations. For Rogers (1983, p. 312) "Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system". Diffusion can be understood as a social change from changes in the face of structures in the social system.

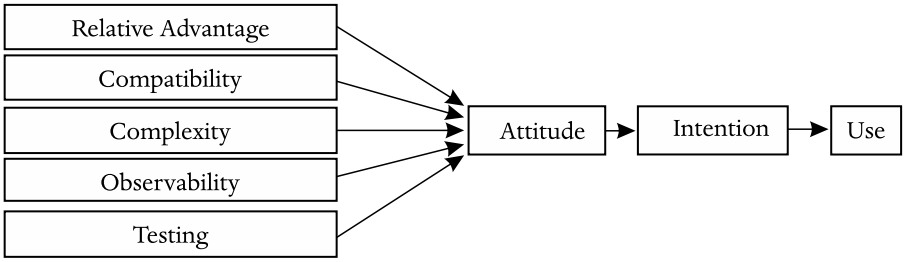
Based on an extensive literature review, Rogers (1983) proposed that five characteristics of an innovation would be crucial to its adoption process: a) Relative advantage represents the degree to which an innovation is perceived to be better than all other options; b) Compatibility reflects the degree to which an innovation is perceived to be consistent with the values, needs and experiences of potential adopters; c) Complexity reflects the degree to which an innovation is perceived as difficult to understand or use; d) Observability reflects the degree to which the benefits or attributes of an innovation can be seen by potential adopters; e) Testing refers to the degree to which an innovation can be experienced before its adoption (Figure 2).

Moore and Benbasat (1991) developed an instrument to measure the early adoption and possible diffusion of technological innovations within organizations. At the five dimensions proposed by Rogers (1983), Moore and Benbasat (1991) added two other characteristics: image, which refers the degree to which the use of an innovation enhances the image or status of the potential adopter within their social system; willingness to use, defined as the degree to which the use of an innovation is an act of free will by the potential adopter. During scale refinement, Moore and Benbasat (1991) divided the construct observability into two other constructs, demonstrability of results and visibility. Demonstrability refers particularly to the extent to which an innovation can be observed before it is adopted, and visibility refers to the degree to which the benefits of an innovation are visible to potential adopters.

Rogers (1983) and Moore and Benbasat (1991) were concerned only with the characteristics of innovation, as perceived by the potential adopter. In other words, for the authors, the adoption of an innovation would

not depend on the context of the potential adopter, which proved to be a limitation in adoption studies. On the other hand, these models proved to be very practical in providing the essential elements that an innovation should have in order for its adoption potential to be enhanced. Thus, returning to the example of the adoption of active learning methodologies, the more the professor realized that active learning methodologies are advantageous, compatible with the professors' teaching style, not very complex, easily observable in the workplace and easily testable, the greater the likelihood that professors will adopt active learning methodologies in their teaching practices.

Figure 2 Representation of the IDT



Source: based in Rogers (1983)

Technology Acceptance Model (TAM)

The Technology Acceptance Model was proposed by Davis (1989) to predict acceptance and use of new information technologies within organizations. According to the model, the intention to use a new information technology depends on the perception about the usefulness of using the new technology and the perception about the ease of using the new technology (Figure 3). Perceived usefulness refers to the degree to which individuals believe that using a new technology improves an individual's performance at work (DAVIS, 1989) while ease of use refers to the degree to which individuals realize that using new technology requires no additional effort (DAVIS, 1989). The model was developed with the belief that the performance gains from adopting a new technology are often, obstructed by users' unwillingness to accept and use available systems.

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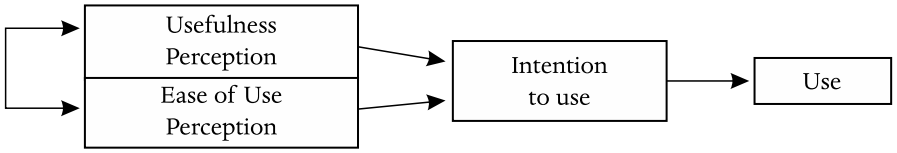
Although initially designed to examine the adoption of technological innovations in the workplace, TAM has been used very successfully in various contexts. For example, if a professor believes that active learning methodologies are easy to apply and that adopting these methodologies will improve teacher performance, the greater the probability they will adopt active learning methodologies in their teaching practices.

Figure 3 Technology Acceptance Model (TAM)



Source: based in Davis (1989).

Decomposed Planned Behavior Theory (DTPB)

The Decomposed Planned Behavior Theory (DTPB) was proposed by Taylor and Todd (1995) to specifically examine the adoption of new technologies in information technology contexts. This theory brings together in a single model the constructs of TPB, the Innovation Diffusion Theory (ROGERS, 1983) and the Technology Acceptance Model (DAVIS, 1989) to explain the adoption behavior of a new information technology.

For Taylor and Todd (1995), the main objective of much research is to evaluate the value of Information Technology for an organization as well as the determinants of its adoption. Taylor and Todd (1995) used TAM (DAVIS, 1989) and two variations of TPB to evaluate which model best helps to understand the use of new information technologies. According to Taylor and Todd (1995), various theoretical perspectives were being used to provide an understanding of the determinants of using a new technology. In a way, therefore, the model proposed by Taylor and Todd (1995) is an aggregation of the constructs of the various theories into a single model in order to provide a better explanation of the adoption of a new technology.

In DTPB, the attitude towards technology adoption is split into three sub-constructs: perceived usefulness, ease of use and compatibility. Norma-

tive beliefs relate to the opinions of the most important reference groups within an organizational environment (peers, superiors, and subordinates). Beliefs about behavioral control are also split into two constructs: self-efficacy and facilitating conditions. Self-efficacy refers to the ease of using new technology and facilitating conditions refer to the physical and technological resources that facilitate the adoption of new technology.

As can be seen from Figure 4, most of the constructs of this model are contained in earlier innovation adoption models. For example, perceived utility and ease of use came from TAM; compatibility came from IDT; the subjective norms came from TRA, whereas perceived behavioral control came from the TPB.

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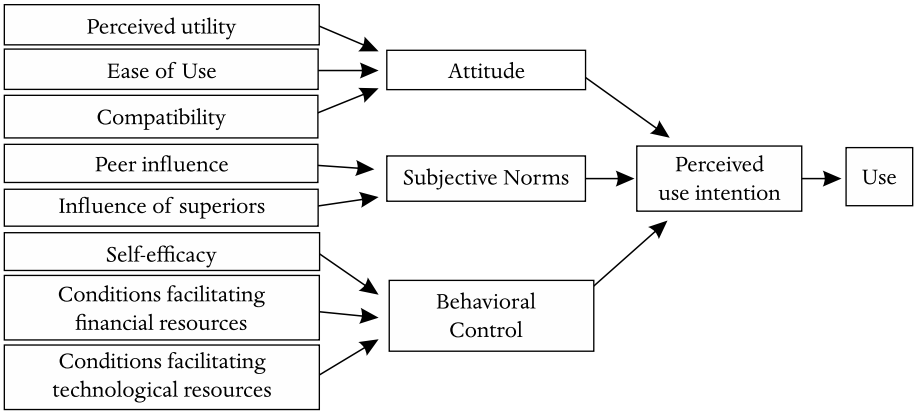
Figure 4 Representation of DTPB



Source: based in Taylor and Todd (1995, p. 146).

APPLICATION OF INNOVATION ADOPTION THEORIES IN STUDIES ON TEACHING TECHNOLOGIES, METHODOLOGIES AND PRACTICES

Adoption theories and models have been used in education to investigate the adoption by professors of technology as well as teaching practices and methods. This section illustrates some studies that aimed to examine how these theories can be successfully applied in the field of education.

Technology Adoption Behavior by Professors

Sugar, Crawley and Fine (2004) examined professors' beliefs regarding their decision to adopt new classroom teaching technologies. They investigated elementary and high school teachers in the southeastern United States, using the TPB model by Ajzen (1985), using the mixed method of analysis. Overall results indicated that educational technology adoption decisions were influenced by personal beliefs about the consequences of adoption, namely: prepare students for their future careers; expose students to a variety of new technologies; ensure student interest; enable students to acquire additional skills; and make students depend on technology. Still according to study results, 68% of respondents had adopted at least one technology and more than two thirds of teachers surveyed had favorable beliefs about adopting a new technology. However, attitude was the best predictor of teachers' intention to adopt a new technology.

Ajjan and Hartshorne (2008) investigated faculty decisions to adopt Web 2.0 tools as text messaging, wikis, social networks and other applications using as a model the DTPB. In their study, Ajjan and Hartshorne (2008) concluded that attitudes and perceived behavioral control have a strong positive influence on their intention to use Web 2.0 technology, but the same was not evident for subjective norms. The results also showed that ease of use, usefulness and compatibility are the main determinants of the attitude of using Web 2.0 technologies, suggesting that training is an important influencing mechanism for using Web 2.0. The results also indicated that faculty attitude and perceived behavioral control are strong

predictors of their intention to use Web 2.0, this being a strong predictor of actual behavior. The adoption of Web 2.0 was also the subject of the study by Yusop (2015) and the results showed that all TAM constructs were significant to explain the future intention of adopting this technology.

By extending the technology acceptance model, Lee (2006) investigated the factors affecting the adoption of the e-learning system in compulsory and voluntary situations. The study showed that perceived utility and ease of adoption were two determining factors in adopting the new technology, namely, both influenced the attitude of individuals towards the use of a particular technology, whereas attitude and perceived utility can predict an individual's intention to use technology. The adoption of e-learning in higher education was also the subject by Singh and Hardaker (2014) and the results suggested that the adoption of e-learning in higher education depends on both institutional and individual level processes.

Tondeur et al. (2008) analyzed the relationship between teachers' teaching beliefs and the typical approach to classroom computer use. The sample by Toundeur and his colleagues consisted of 574 elementary school teachers and included both teachers with traditional beliefs about teaching and teachers with beliefs in the constructivist model of education. The results suggested four distinct teacher profiles and that teachers with relatively strong constructivist beliefs who also have strong traditional beliefs report a higher frequency of computer use.

Lee, Cerreto and Lee (2010) investigated a sample of elementary and high school teachers to evaluate the use of classroom teaching technology. The aim of the investigation was to use TPB to examine the underlying beliefs and relative strengths of the three direct determinants, attitude towards behavior, to subjective norm and perceived behavioral control over teachers' intention to use a specific technology in the classroom. The results revealed that the attitude towards the behavior, subjective norm and perceived behavioral control were all significant predictors of teachers' intention to adopt a specific classroom technology. Teachers with positive attitudes about using computers to prepare and teach classes are less concerned with what others think of this practice (subjective norms) and less

bothered by internal or external constraints (behavioral control). Teachers expressed a variety of behavioral beliefs, normative beliefs, and control beliefs about using computers to prepare and teach classes. Behavioral beliefs about computer use focus on two areas: improvement of student teaching and behavior (normative beliefs and control beliefs).

Hussein and Mourad (2014) developed a study to investigate issues related to the adoption of a specific technological innovation, WebCt/virtual platform by professors and education administrators. Research has developed a conceptual framework for understanding why teachers and administrators embrace or disagree with technology innovations. The literature review showed the different factors that are used to study the adoption of innovation, in addition to providing empirical evidence on significant findings. Hussein and Mourad (2014) used the decision-making process model in innovation by Rogers (1983) and research context was Egypt's higher education market. The research used the quantitative method to measure the dependent and independent variables of the main constructs, test the proposed model and the established scales. Hussein and Mourad (2014) brought as main contribution to the work empirical data centered on the identification of marketing factors that affect the adoption of web technology in universities. The analysis reveals significant explanatory power of all attributes of perceived innovation characteristics on technology adoption in the higher education market.

Table 2 summarizes the results of the research discussed above about teacher adoption of new technologies. The significantly positive independent variables that determine technology adoption behavior are: attitude, intention to use, perceived ease, perceived content quality, self-efficacy; behavioral beliefs, teaching beliefs, subjective norms, among others listed below.

Table 2 Research on determinants of professor adoption of teaching technologies

AUTHOR (YEAR)	DEPENDENT VARIABLES	INDEPENDENT VARIABLES	CONTEXT	BASE THEORY
Sugar, Crawley and Fine (2004)	Technology Adoption Behavior	Attitude (+)	Professors' beliefs about technology adoption as a personal decision making process, in four schools in the southeastern United States	TPB
Ajjan and Hartshorne (2008)	Technology Adoption Behavior	Attitude (+); Perceived utility (+); Ease of Use (+)	Faculty Decision to Adopt Web 2.0 Classroom Tools.	TPB DTPB
Tondeur et al. (2008)	Computer Adoption Behavior From Teaching Belief	Behavioral beliefs (+): Constructivist Teaching Beliefs (+).	Traditional and constructivist teaching beliefs of elementary school teachers in the use of computers in the classroom.	TPB
Lee, Cerreto and Lee (2010)	Computer adoption behavior for preparing and teaching classes.	Attitude towards behavior (+); Subjective norm (+); Perceived Behavior Control (+); Behavioral beliefs (+); Normative beliefs (+); Control Beliefs (+)	Professors' Decisions on the Use of Educational Technology.	TPB
Hussein and Mourad (2014)	Technology Innovation Adoption Behavior	Innovation Attributes (+); service provider (+); need for interaction (+)	Determinants of adoption of technological innovations such as Web/CT by Egyptian university professors.	TPB TAM

Source: Authors.

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Adoption of Teaching Methods and Practices by Professors

In studies on the adoption of methodologies and teaching practices by professors, TPB and DTPB were used, addressing issues as diverse as the adoption of new teaching practices by professors in Education and the Environment (SHUMAN; HAM, 1997), the insertion of environmental sustainability in the school curriculum (KALU; UWATT; ASIM, 2004), introducing new skills in teaching (USHER; PAJARES, 2008), professors' self-efficacy as a determinant of positive educational outcomes (HOLZBERGER; PHILIPP; KUNTER, 2013), and the adoption of professors' knowledge in their professional practices (FIVES; BUEHL, 2014).

Shuman and Ham (1997) identified that some teachers were more committed than others to environmental education (EE). The determining factors investigated of professors' commitment to teach Environmental Education were the significant life experiences, beliefs and Attitudes about teaching Environmental Education concepts. The authors described the commitments of EE teachers, as well as the explanatory power for use in the proposed model of Commitment to Environmental Education (CEE). A preliminary life experience measurement scale was developed, given the lack of a life experience construct directly related to the teaching of EE.

Research conducted in Nigeria, by Kalu, Uwatt and Asim (2004), showed that teachers' attitude towards teaching environmental sustainability topics in the curriculum and their attitude towards environmental issues are significantly positive, from data collection with an attitude questionnaire, in a sample of 328 elementary and high school teachers. The justification for the research was the government regulation that inserted, in 2003, the theme Environmental Sustainability in the national curriculum for Elementary and High School. However, the survey also showed that teachers in the survey sample lacked the necessary knowledge to effectively teach environmental issues. On the other hand, the attitude was significantly positive due to the government's awareness of "environmental problems". The study results also showed that factors such as educational level (Elementary and Secondary), teacher's gender, teacher's teaching experience, teacher's educational qualification were not significantly influenced

by the teacher's attitude towards environmental sustainability teaching in the curriculum.

Usher and Pajares (2008) primarily examined the role of students' self-efficacy during learning concluding that self-efficacy is influenced by contextual factors, such as gender, ethnicity, academic ability, and academic mastery. Usher and Pajares (2008) stress that self-efficacy beliefs are created and developed by the way individuals interpret information and the outcome of their own previous accomplishments or experience, being changeable when individuals are confronted with new tasks.

Holzberger, Philipp and Kunter (2013) developed a longitudinal study aiming at analyzing professors' self-efficacy. The research measured the self-efficacy perceived by professors themselves and students regarding instructional quality from the cognitive, evaluative, classroom management, and individual learning support aspects for students. The study showed that professors with high self-efficacy beliefs are those who work harder, are more involved in informal learning activities. They are more determined and less stressed, having positive effects on the results of the teaching and the learning ability of students. In short, Holzberger, Philipp and Kunter (2013) concluded that even professors with many years of teaching experience changed their self-efficacy beliefs throughout the school year, awakening the need to examine the self-efficacy of professors not only as a cause, but also as a consequence of educational processes.

Fives and Buehl (2014) suggested that professors differ in their ability to engage in teaching experience and that these differences can be explained by their beliefs as the importance of knowledge for professional practice. From the authors' perspective, beliefs act as filters and can influence the way information and experiences are viewed or understood by the individual in order to frame their tasks and the results of their study. As a matter of fact, it demonstrated that professors' beliefs about their own teaching ability can be used to identify professors' practices related to different perspectives on teaching ability.

Cheng (2015) investigated perceptions about teaching ethics using three variations of the Theory of Planned Behavior (TPB). The results of

this study suggested that for professors to teach an Ethics course it is critical that department heads increase professors' self-efficacy, which, in turn, will lead them to greater positive intentions to teach Ethics courses, contributing to the effectiveness of the classroom.

Table 3 summarizes the results of studies on professors' adoption of teaching methods and practices. The determinant variables of the adoption behavior of teaching methods and practices are: attitude, life experience, beliefs and attitudes about teaching, behavioral control, self-efficacy, behavioral beliefs, subjective norms, normative and control beliefs, and knowledge of teaching content, listed below.

How to apply adoption theories and models in education

As seen in the previous section, innovation adoption theories can be successfully used in education. For example, these theories and models can be used to predict the adoption of new technologies such as distance education platforms, teaching methods and practices as active learning methodologies, disciplines such as Business Ethics and even cross-sectional themes such as Sustainability. The first step, therefore, is to define the object of interest of the investigation.

The second step is to choose the theory or theories that will be examined. The more constructs included in the model, the greater the likelihood of increasing the model's explanatory power. However, the greater the number of constructs examined, the greater the risk that the variables are non-discriminating or that there is strong multicollinearity. Therefore, it is best to select only constructs that are more likely to be significant in the context of the investigation.

The third step is to select the sample framework, i.e., which set of professors to investigate and determine how the sample can be properly selected and recruited. The next step is to develop the data collection questionnaire. In our experience, this is one of the most challenging tasks for researchers who are unfamiliar with quantitative methods or scaling. To facilitate this task, we have adapted the scales for some of the constructs discussed in the previous section (Table 3). Naturally, a researcher willing to

Table 3 Relational study frame of reference to teaching methodologies and practices adopted by professors

AUTHOR (YEAR)	DEPENDENT VARIABLES	INDEPENDENT VARIABLES	CONTEXT	BASE THEORY
Shuman and Ham (1997)	Behavior	Life experiences (+) Beliefs and attitudes about teaching EE concepts (+)	Professors' Commitment to Education and Environment. Sample with 232 UK environmental educators	TPB
Kalu, Uwat and Asim (2004)	Behavior	Attitude (+); Behavioral control (+); Subjective Norms (+).	Determine the nature and extent of teachers' attitude towards environmental sustainability issues in the school curriculum, from elementary and secondary schools in the Calabar Education Zone of Cross River State, Nigeria.	TPB
Uscher and Pajares (2008)	Professor self-efficacy beliefs regarding career choice.	Self-efficacy (+)	Self-efficacy beliefs of professors in academic contexts.	DTPB
Holzberger, Philipp and Kunter (2013)	Teacher self-efficacy as a determinant of positive educational outcomes.	Self-efficacy (+)	Teacher self-efficacy beliefs in the educational process as part of the construct as a determinant of school success.	DTPB
Thurlings, Evers and Vermeulen (2015)	Innovative professor behavior	Atitude (+), Behavioral beliefs (+); Self-efficacy (+);Knowledge of teaching content (+)	Preliminary model of factors that improve innovation behavior in educational organizations.	TPB DTPB
Fives and Buehl (2014)	Professors' behavioral beliefs and the importance of knowledge in teaching ability.	Behavioral beliefs (+), Knowledge (+)	Teachers' beliefs in their teaching ability and differences in teachers' view of knowledge in their professional practice. Various levels of education in the USA.	TPB

Source**:** Authors.

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use adoption models in the field of education must choose the theories and constructs they wish to include in the study and adapt the scales according to the research theme and purpose. The scales reported in Table 4 could be used to investigate the adoption of a new technology in the university environment as a distance education platform in the context of Higher Education Institutions (HEI).

Once the data has been collected, the next step is to analyze the data. Most researchers employ multivariate data techniques that have the ability to analyze both the measurement model and the structural model. The most commonly used software operationalizes covariance-based Structural Equation Modeling like AMOS and Lisrel or Partial Least-Square Structural Equation Modeling like SmartPLS. Each of these techniques has its advantages and disadvantages and the interested researcher should look for further information before deciding on either method of analysis.

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Table 4 Example of Adapting Innovation Theory Scales

CONSTRUCTION	Scale Items	Source
Perceived utility of <technology>	Using <technology> in my teaching practice would allow me to teach better. Incorporating <technology> into my everyday life would improve my classroom performance. Using <technology> in the disciplines I teach would increase the productivity of my classes. Incorporating <technology> into my teaching practice would improve the efficiency of my classes. <Technology> would make my job as a professor easier. <Technology> would be very useful for my teaching practice.	Davis (1989).
Easy to adopt <technology>	It would be easy for me to use <technology> in my teaching practice. It would be easy for me to learn how to use <technology> in my daily life as a professor. My interaction with <technology> would be clear and understandable. It would be easy for me to enable myself to use <technology>. It would be easy for me to make <technology> have the effect I wanted. Incorporating <technology> into the disciplines I teach would be very easy for me.	Davis (1989); Taylor and Todd (1995).
<Technology> compatibility	Using <technology> is compatible with my teaching style. Adopting <technology> is completely compatible with my life. I think using <technology> would suit the way I teach. Adopting <technology> would suit my lifestyle.	Moore and Benbasat (1991); Taylor and Todd (1995).

to be continued...

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Relative advantage of <technology>	Using <technology> in my daily life would improve my teaching practice. Adopting <technology> would improve the quality of my classes. <Technology> would make it easier to teach my classes. The advantages of using <technology> would outweigh the disadvantages. <Technology> would improve my teaching performance. In general, I believe <technology> would be a great advantage for my classes. <Technology> would give me more control over my classes. Using <technology> would improve the productivity of my classes.	Moore and Benbasat (1991); Taylor and Todd (1995).
Image in relation to the adoption of <technology>	Using <technology> would improve my image in the HEI where I teach. Using <technology> would make other people in my HEI see me as a better professor. If the other professors in my HEI used <technology>, they would have more prestige than those who did not use it. Professors in my HEI using <technology> would have a better image. Professors in my HEI who use <technology> in their subjects have more status in my institution.	Moore and Benbasat (1991).
Subjective norms regarding the adoption of <technology>	My most important work friends think I should start using <tech >. My coordinator thinks I should use <technology>. The professors I work with think that I should use <technology>.	Fishbein e Ajzen (1975) and Taylor and Tood (1995).

to be continued...

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Perceived behavioral control in relation to the adoption of <technology>	I would know how to use <technology>. Using <technology> in everyday life would be entirely within my domain. Eu teria os recursos necessários para usar a <tecnologia>. I would have the knowledge to use <technology>. I would have the necessary skill to explain <technology>.	Ajzen (1991) and Taylor and Todd (1995).
Attitude towards <technology> adoption	Useless - Useful. Bad idea - Great idea. Foolish - Sensible. Nothing important - Very important. Irrelevant - Relevant. Nothing smart - Smart. Very unlikely - Very likely. Negative - Positive. Simple - Complex.	Fishbein and Ajzen (1975) and Taylor and Todd (1995).
Intention to adopt <technology>	I will discuss with mystudents ways of using <technology>. I intend to discuss with my course coordinator the use of <technology>. I intend to use <technology> in my daily life. I will try to convince my fellow professors to use <technology>. I intend to search for more information in order to use <technology>. I plan to discuss with my fellow professors how to use <technology>.	Taylor and Todd (1995).

Source: Authors.

FINAL CONSIDERATIONS

The objective of this paper was to analyze how innovation theories can be applied to identify the determinants of professor behavior in the adoption of technology, teaching methods and practices, seeking to identify new variables and constructs, for the development and expansion of theoretical models. In this context, it must be considered that the insertion of teaching technologies, methods and practices is permeated by numerous challenges, among them the professors' behavior, to disseminate in the disciplines the phenomena of national and international realities.

It is important to highlight that, besides the studies that were discussed, there are gaps for future research on professor behavior, which can also use the Theory of Planned Behavior, the Innovation Diffusion Theory, the Technology Acceptance Model and Decomposed Planned Behavior Theory. Among these gaps, the importance of inserting some subjects in business courses is a subject that has been pointed out in several qualitative research that require investigations, which reaffirms the proposal of an agenda of quantitative studies from the mentioned theories.

The results presented here may have practical implications, as greater attention in the continuing education of teachers for the inclusion of themes related to sustainability in their subjects, as well as other educational supports that converge to improve the attitude of teachers towards behavior widely discussed in this research on adoption of teaching technologies, methods and practices.

The inclusion of new curriculum components presupposes the need for professor engagement, especially, regarding the challenges facing society in emerging issues that must be updated in the pedagogical projects. Thus, identifying the determinants of professors' behavior in the adoption of traversing themes such as: ethics, environmental education, social responsibility, social management, environmental management, conscious consumption, among others, is critical to understand the predictors that facilitate or cause resistance in professors to insert some new content into their subjects.

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It can be concluded that teachers play a strategic and decisive role in the inclusion of themes in the classroom, and that there is a need for reflection and evaluation of the efforts undertaken, to build a discussion focused on education paradigms and the elaboration of their practices involving several themes related to sustainability. This is necessary for enhancing the role of higher education, especially in business courses, and to put this theme in the classroom, so that future professionals can develop their management activities with a greater reflection on their role in society.

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