


Article

Predicting Students' Behavioral Intention to Use Open Source Software: A Combined View of the Technology Acceptance Model and Self-Determination Theory

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Abstract: This study focuses on students' behavioral intention to use Open Source Software (OSS). The article examines how students, who were trained in OSS, are motivated to continue using it. A conceptual model based on Self-Determination Theory and the Technological Acceptance Model (TAM) was defined in order to test the behavioral intention to use OSS, comprising six constructs: (1) autonomy, (2) competence, (3) relatedness, (4) perceived ease of use, (5) perceived usefulness and (6) behavioral intention to use. A survey was designed for data collection. The participants were recent secondary school graduates, and all of them had received mandatory OSS training. A total of 352 valid responses were used to test the proposed structural model, which was performed using the Lisrel software. The results clearly confirmed the positive influence of the intrinsic motivations; autonomy and relatedness, to improve perceptions regarding the usefulness and ease of use of OSS, and; therefore, on behavioral intention to use OSS. In addition, the implications and limitations of this study are considered.

Keywords: Open Source Software (OSS); Technology Acceptance Model (TAM); Self-Determination Theory (SDT); behavioral intention to use; student; secondary school

1. Introduction

Information and Communication Technologies (ICT) have become a crucial element for students in their daily educational tasks [1–4]. Nowadays, it is possible to affirm that education without ICT is unimaginable [5]. In fact, many institutions and governments have developed strategies in order to integrate ICT with pedagogical methods [6,7]. In this context, the adaptation of pedagogical systems and the incorporation of ICT innovations are essential to the survival of many educational institutions [8,9]. Nevertheless, the involvement of three factors is required in order to achieve efficient and effective use of ICT for educational purposes [10]: (1) the academic community; (2) educational structures; and (3) legislation.

This study focuses on the adoption of Open Source Software (OSS) in education. According to [11], the three OSS primary drivers in education are: (1) lowered acquisition costs; (2) relaxed licensing agreements; and (3) interoperability. In this respect, OSS is one of the ICT's with the greatest growth potential in the field [12,13]. Indeed, many governments are adapting their regulations or investing in new infrastructures to promote OSS use in education. For instance, OSS adoption in higher education has been popular in the United States [14]. In a similar way, the government of Andalusia (Spain), which exercises regulatory and executive power in different areas, including education, has approved some initiatives to boost the use of OSS in primary and secondary education [15].

Generally, OSS has achieved enormous popularity due to three factors [16]: (1) user-developer interaction; (2) market potential; and (3) development stage. Two key OSS features are highlighted [17,18]: (1) it is developed in a public and collaborative manner; and (2) the source code is accessible for users, and they can modify it, and in most cases, its distribution is even allowed. Therefore, OSS is considered a viable alternative to proprietary software for many institutions [19,20], becoming an innovative global movement where different social, economic, and public agents collaborate, united by the need to control the software design [21]. Consequently, the number of OSS projects in the world has increased significantly in recent decades in all fields [22,23].

Particularly, the implementation of OSS in the educational context is a reality [12,15]. OSS usually increases the quality of education in three aspects [24]: (1) service level; (2) student productivity; and (3) student satisfaction. In addition, OSS shares similar goals with educational principles, such as collectiveness and cooperation [12]. Hence, educational organizations should define OSS strategies considering the different needs of the stakeholders, mainly students, and teachers, in order to spread the OSS principles and benefits [25]. Indeed, according to [26], students and teachers agree that the total cost of ownership is one of the most important factors in OSS adoption.

However, the literature has not sufficiently explored certain issues surrounding the transmission to students regarding the values associated with OSS and its subsequent application in other fields. In this manner, these questions could be the starting point for the present paper: (1) Do students adopt a favorable behavior towards the OSS use as a result of the training received?; (2) Do students consider that OSS provides a solid alternative to proprietary software?; and (3) Are students motivated to use OSS after receiving training focused on OSS?

Consequently, there is a gap in our knowledge concerning the impact of education and the intention to continue using this type of ICT. Thus, this paper seeks to fill part of that gap. Specifically, two research objectives are defined: (1) to explore the motivational determinants of student behavior towards OSS; and (2) to propose a research model to analyze the effect of self-motivation factors in order to gain a deeper understanding of the relationship between human motivation and technology acceptance. In this regard, this research suggests that students will be active in satisfying their basic software needs within the psychological field. Therefore, theories of motivation could provide a relevant view from which to achieve the proposed objectives. Indeed, this study adopts the perspective of Self-Determination Theory (SDT) in combination with the Technological Acceptance Model (TAM).

The remainder of this article is organized as follows: Section 2 provides the theoretical framework based on both theories and the hypotheses; Section 3 presents the preliminary analysis; Section 4 tests the model; Section 5 discusses the findings that emerged from the analysis. Finally, Section 6 contains the conclusions, addressing the limitations and the implications of the findings.

2. Theoretical Framework

The ICT literature has always been concerned to understand usage behavior regarding ICT [27,28]. In this respect, many studies have revealed that this behavior can vary among individuals or groups [27–29], and behavioral intention to use is frequently analyzed through the application of certain constructs or approaches to address the acceptance of emergent technologies [30]. The Technology Acceptance Model (TAM) is one of the most influential theoretical frameworks to explain users' acceptance of ICT [31].

The TAM was developed by [32] in order to study the usage intention of technology based on the principles proposed by [33] in the "Theory of Reasoned Action". Ever since, this model has been used intensively by researchers to develop predictive models about the intention to use any technology (i.e., Internet, mobile devices, enterprise systems or open software) in any discipline (i.e., medicine, business, education, economics or psychology), and in many cases, the hypothetical relationships have been widely supported [34]. Nowadays, it continues to be one of the main theoretical frameworks for evaluating the use of technology, and its validity for this purpose has been widely demonstrated [35–37].

In the context of education, TAM has been applied to a huge range of purposes. For instance, [38] sought to measure clinical students' perceptions of simulation-based learning using TAM. Also, [39] developed a research model based on the TAM to evaluate the acceptance of mobile technologies among teachers. Moreover, [40] proposed a TAM based model to understand the motivational factors that influence acceptance of the open-source learning management system Moodle.

In any case, the application of the TAM needs to be adapted to a technology or context. Therefore, specific variables related to social and psychological factors that influence user acceptance must be identified [41] to provide more consistent predictions of ICT use. In fact, TAM is often combined with other theories that support the inclusion of such variables [42]. Hence, TAM has been extended using external factors from other ICT theories depending on technological characteristics, target users, and context [43].

One relevant limitation of the TAM that must be considered in the current study pertains to the omission of intrinsic motivations and social influence [15]. According to [44], the explanation of the TAM may be limited when ICT acceptance and use are not only to achieve tasks or procedures but also to fulfill emotional needs. In fact, some extensions of the TAM, such as TAM2 and TAM3, have been proposed to incorporate these needs in order to improve its predictive capacity.

Additionally, since this study is linked, in part, with students' emotions regarding OSS acceptance, SDT has been used to identify the external variables that complete the acceptance model. This theory is focused on identifying the reason behind an individual's autonomy in the development of any type of activity [45]. Indeed, the combination of the TAM and Self-Determination Theory has been widely used by the literature in recent years [46–48], and the compatibility of both has been robustly demonstrated [49]. Following the foundations of both frameworks, the hypotheses will be shown in two groups: (1) related to the TAM and (2) related to SDT.

2.1. Technological Acceptance Model

The original proposal for the TAM [32] is made up of five concepts: perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual use. Following Davis' proposal, the relationships between these constructs are illustrated in Figure 1. In fact, the defined model in this study is inspired by this framework whilst adopting a TAM2 and TAM3 perspective. This implies that it is assumed the incorporation of their three key constructs [50,51]: perceived usefulness (PU), perceived ease of use (PEU) and behavioral intention to use (BI), so that the two belief constructs (PU and PEU) are primary determinants of an individual's BI to use an ICT [52]. The TAM literature considers the removal of the construct attitude towards use to be viable, owing to its reduced mediating effect on BI [39].

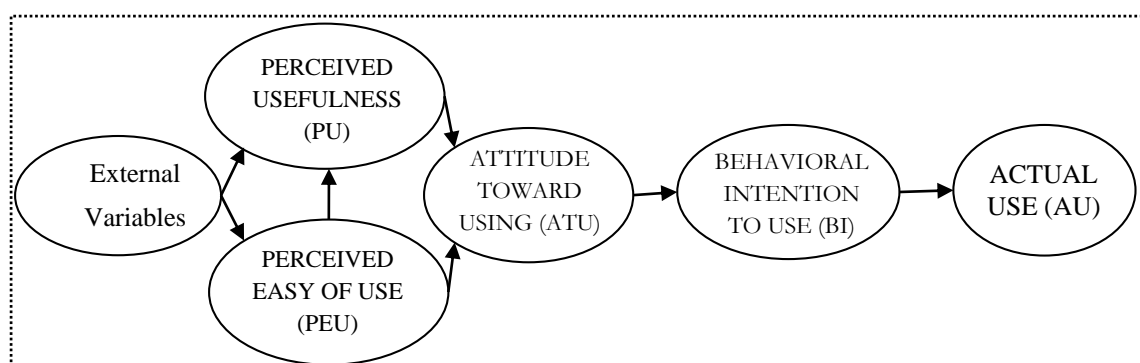


Figure 1. Technology Acceptance Model (TAM) original proposal [32].

TAM3, which includes TAM2, was proposed initially as a means of understanding employee use of ICT in a business environment [51]. It emphasizes individual and social factors that influence the individual-level adoption behavior of an ICT [53]. Hence, the user perception of technology determines its level of acceptance. Specifically, TAM3 [50] takes the variables from TAM2 that influence PU (voluntariness, experience, subjective norms, job relevance, output quality and results in demonstrability), proposing

that the anchor (computer self-efficacy, perception of external control, computer anxiety and computer playfulness) and adjustment (perceived enjoyment and objective usability) factors impact PEU.

PU is defined by [32] (p. 320) as “the degree to which a person believes that using a particular system would enhance his or her job performance”, and PEU is “the degree to which a person believes that using a particular system would be free of effort”. Based on the TAM postulates, PEU and PU are factors that influence BI [50], and the impact is assumed to be positive. Hence, in this present study, the greater the students’ PEU and PU regarding OSS, the more likely the students’ BI. Thereby, the following hypotheses were included in the TAM3 model (Figure 2):

Hypothesis 1 (H1). *Perceived ease of use (PEU) has a positive effect on the perceived usefulness (PU) of OSS.*

Hypothesis 2 (H2). *Perceived ease of use (PEU) has a positive effect on behavioral intention to use (BI) OSS.*

Hypothesis 3 (H3). *Perceived usefulness (PU) has a positive effect on behavioral intention to use (BI) OSS.*

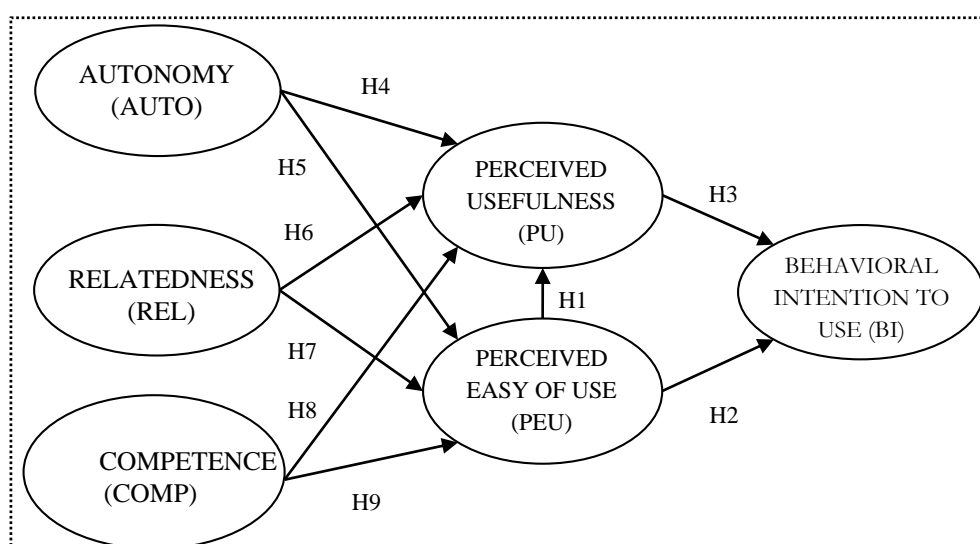


Figure 2. Research model.

2.2. Self-Determination Theory (SDT)

SDT is a theoretical framework proposed by [54] to help define comprehensive behavioral models. This theory seeks to understand the socio-environmental factors that affect an individual’s tendency towards self-motivation. Indeed, SDT affirms that individuals can improve their optimal functioning and well-being by engaging in activities that interest them [55,56].

It is considered one of the leading motivational theories today [57]. SDT has been used to tackle motivational studies across many disciplines, including: healthcare [58], writing [59], human resources [60,61], education [62–64], organizations [65–67], and sport [68], among others.

Three basic psychological needs are identified by this theory: autonomy, relatedness, and competence [69]. They are postulated as central intrinsic motivations, which refer to doing something because it is inherently interesting or enjoyable [70]. Conversely, extrinsic motivations appear when behaviors are performed because of external forces [71,72]. Furthermore, SDT does not differentiate between the strength of these needs, although the literature related to this theory suggests that autonomy is considered more essential than the other two [73].

SDT proposes that individuals try to be motivated to satisfy these needs [58]. In general, SDT considers that competence is related to a sense of self-efficacy or perceived ability to attain objectives. Hence, it is a need to feel effective [74]. Moreover, autonomy refers to the sense of behavior self-regulation [75]. Finally, relatedness is likened to the need to be integrated into a larger group [69]. So, each of these motivations

are analyzed in order to complete the research model, considering that educational contexts that are supportive of autonomy, competence, and relatedness help to increase the internalization and integration of these three needs [76].

2.2.1. Autonomy

In contrast to forced regulation by external agents, autonomy is related to regulation by the self [45]. It refers to the need to be autonomous [77], and, therefore, it pertains to those personal acts through which individuals control their own behavior. Obviously, this sense impacts directly on the way of behaving due to its capacity to stimulate voluntary acts, even if they come from external initiatives [78]. In this regard, SDT does not deny the presence of contingencies, although it is focused on a person's endorsement of the act itself [45].

In the educational context, students usually have a sense of learning autonomy [48,79]. It is a psychological state through which students perceive internal control over learning goals and outcomes [80]. In fact, autonomy impacts on student satisfaction. According to [47], motivation based on autonomy has a higher impact on satisfaction than external motivations.

Furthermore, autonomy could lead to greater performance when the tasks are interesting to individuals who are performing them [73]. In addition, evidence shows that the presence of a supportive autonomy environment can increase the tendency to develop a specific behavior [81,82]. Hence, educational systems geared towards the provision of rationale, the provision of choice, and the encouragement of critical thinking are more likely to foster autonomy among students [83]. In fact, entrepreneurship students have a high degree of autonomy and therefore have a greater capacity to initiate actions [79].

Extending this motivational reasoning to an educational context, where the use of OSS is incentivized, autonomous acts would influence the PU and PEU of OSS. Indeed, previous studies have shown the positive relationship between perceived autonomy and perceived usefulness and perceived ease of use in a huge range of ICT contexts [48,84,85]. Based on these, the following hypotheses propose that autonomy exerts an influence on the PU and PEU of OSS (Figure 2):

Hypothesis 4 (H4). *Autonomy (AUTO) has a positive effect on the perceived usefulness (PU) of OSS.*

Hypothesis 5 (H5). *Autonomy (AUTO) has a positive effect on the perceived ease of use (PEU) of OSS.*

2.2.2. Relatedness

Relatedness refers to the need to establish emotional links with other individuals [75]. In an educational context, relatedness pertains to the capacity to engage in tasks that allow for collaboration and communication with other students [63]. Also, according to SDT, a student can enjoy social interactions and social connections [80].

Educational literature shows that relatedness is the least studied need [84]. Nonetheless, some research has shown that relatedness is a strong predictor of learners' intention to continue in an educational program [85]. Perhaps it is due to the intrinsic characteristics of the educational environment, where a student can develop the ability to initiate connections with others, from which it is possible to foster the generalization of relevant behaviors [45].

In this respect, relatedness can reduce fears and increase the tendency to share with others knowledge related to the OSS features [84]. In the field of ICT, relatedness is one of the most important incentives. People tend to value the opinions of those to whom they feel connected as highly relevant [85]. Therefore, the following hypotheses have been proposed (Figure 2):

Hypothesis 6 (H6). *Relatedness (REL) has a positive effect on the perceived usefulness (PU) of OSS.*

Hypothesis 7 (H7). *Relatedness (REL) has a positive effect on the perceived ease of use (PEU) of OSS.*

2.2.3. Competence

This need refers to effective behavior, the expansion of personal capabilities, and the desire to be enough [48]. In this context, SDT indicates that competence allows individuals to master tasks or achieve aims with ease [55]. When this basic need is satisfied, individuals begin to acquire the feeling of being effective in developing tasks [54].

According to [49], in the field of ICT, the need for competence is associated with factors such as (1) job satisfaction; (2) levels of job burnout; (3) experience in using technology; (4) expectations of the outcomes of using computers; (5) emotional reactions to computers; and (6) actual computer use, among others. Consequently, it is possible to define a relationship between competence and the degree to which people benefit from the use of ICT [86].

In addition, previous studies carried out in the educational context have shown that there is a relationship between competence and the constructs PU and PEU [87]. In our case, students' competence corresponds to the need to become more effective in the use of OSS in order to achieve high academic levels [88]. This is because competence is expected to make students more effective in their OSS use. This anticipation would increase the PU and PEU of OSS. The following hypotheses have been defined (Figure 2):

Hypothesis 8 (H8). *Competence (COMP) has a positive effect on the perceived usefulness (PU) of OSS.*

Hypothesis 9 (H9). *Competence (COMP) has a positive effect on the perceived ease of use (PEU) of OSS.*

3. Methods

3.1. Participants and Procedure

The study was conducted at secondary schools within the Education System of Andalusia, Spain, between April 2019 and September 2019. The participants were recent secondary school graduates in order to ensure that all the participants had received enough OSS training before the interviews since OSS use in the classroom was mandatory. The instrument used was a web-based survey developed with Google Form. A web-based survey offers three advantages to the study [89]: (1) it prevents transcription errors, (2) it enables reachability to many participants in a short space of time, and (3) it ensures anonymity. Students were informed of the objectives of the study. A total of 352 students completed the survey. The demographic profile of the respondents is given in Table 1.

Table 1. Demographic profile of the participants.

Characteristic	Statistic (%)
Gender	
Male	217 (61.64%)
Female	135 (38.35%)
Age	
Less than 20 years old	131 (37.5%)
Between 21 and 25	100 (28.40%)
More than 25 years old	120 (34.09%)
OSS Frequency of use	
All software I use	113 (32.10%)
Minimum Once a day	138 (39.20%)
Minimum Once a week	35 (18.46%)
Rarely	36 (10.22%)

3.2. Measures

The questionnaire was designed considering evidence from prior research on the TAM and SDT. In fact, the scale used to measure the constructs was developed using the measures created by [48,90,91]. Items were identified as indicators for each construct (Appendix A). The questionnaire was composed of two parts. In the first part, responders provided demographic information (Table 1). In the second section, participants were required to indicate their agreement or disagreement with 21 items using a five-point Likert-type scale, ranging from “Not at all/strongly disagree” (1) to “Exactly/strongly agree” (5). The 21 items were grouped into the six constructs of the model.

3.3. Data Analysis

A Structural Equation Model (SEM) was proposed. SEMs are frequently used in work related to behavior [92]. The quantitative data analysis included two processes: (1) an analysis of the descriptive statistics and the reliability of the measurement tool using the SPSS version 24 statistical program; and (2) SEM testing. Specifically, Lisrel 8.80 software allowed us to evaluate the correlation coefficient between variables in factor analysis and the path analysis equation model. A detailed explanation of the application of both analytical procedures and results is given in Section 4.

4. Results

The first stage involves testing the discriminant validity and reliability of the constructs by applying four analytical procedures: (1) assessment of item loadings; (2) internal consistency reliability (Cronbach’s alpha and composite reliabilities); (3) convergent validity; and (4) discriminant validity. The results of applying these analyses are shown in Table 2.

Table 2. Item loadings and measurement reliability.

Construct		Mean	Std. Dev.	Factor Loading	Lambda Stand.	Composite Reliability	AVE	Cronbach’s α
Autonomy (AUTO)	AUTO1	2.97	1.337	0.907	0.900	0.95	0.826	0.949
	AUTO2	2.99	1.368	0.902	0.901			
	AUTO3	2.75	1.339	0.931	0.934			
	AUTO4	2.77	1.327	0.891	0.900			
Competence (COMP)	COMP1	2.64	1.315	0.939	0.941	0.972	0.867	0.96
	COMP2	2.69	1.275	0.929	0.932			
	COMP3	2.50	1.274	0.916	0.917			
	COMP4	2.73	1.265	0.917	0.921			
Relatedness (REL)	REL1	3.01	1.225	0.908	0.910	0.955	0.841	0.955
	REL2	2.91	1.278	0.923	0.922			
	REL3	2.83	1.226	0.936	0.931			
	REL4	2.80	1.237	0.903	0.906			
Perceived Ease to USE (PEU)	PEU1	3.13	1.248	0.931	0.936	0.952	0.87	0.951
	PEU2	3.11	1.253	0.958	0.952			
	PEU3	3.18	1.258	0.905	0.909			
Perceived Usefulness (PU)	PU1	2.94	1.227	0.907	0.912	0.939	0.837	0.94
	PU2	2.99	1.328	0.903	0.926			
	PU3	2.92	1.296	0.906	0.907			
Behavioral Intention to USE (BI)	BI1	3.18	1.301	0.935	0.938	0.969	0.912	0.96
	BI2	3.21	1.342	0.955	0.955			
	BI3	3.24	1.356	0.974	0.972			

4.1. Convergent Validity

To determine whether convergent validity is acceptable, the measurements must fulfill three conditions [93,94]: (1) all item factor loadings with reflective measures must be significant and greater

than 0.70, (2) the composite reliability for each construct must surpass 0.70, and (3) the Average Variance Extracted (AVE) for each construct should be higher than 0.5. In this study (Table 2), the factor loadings for all constructs substantially exceeded the threshold of 0.70, and they were statistically significant at the 0.001 level. In addition, composite reliability scores showed good internal consistency for all constructs (Table 2), and the AVE values were between 0.826 and 0.912, considerably higher than the recommended value of 0.5.

4.2. Discriminant Validity

On the one hand, the values contained in the Correlation Matrix (Table 3) were used to evaluate the discriminant validity of the constructs. The diagonal elements of this matrix were substituted by the square root of the AVE. In all cases, the square roots of the AVE were larger than the inter-construct correlations, and all shared variances between any two different constructs were less than the amount of variance extracted by one of the two constructs [93]. On the other hand, all items loaded more strongly on their corresponding construct than on other constructs [95]. Therefore, these results confirm the discriminant validity of all constructs.

Table 3. Correlation Matrix ¹.

	AUTO	COMP	REL	PEU	PU	BI
Autonomy (AUTO)	0.970					
Competence (COMP)	0.660	0.930				
Relatedness (REL)	0.668	0.675	0.920			
Perceived Ease to Use (PEU)	0.662	0.588	0.686	0.980		
Perceived Usefulness (PU)	0.742	0.616	0.753	0.770	0.910	
Behavioral Intention to Use (BI)	0.630	0.531	0.642	0.714	0.827	0.980

¹ Diagonal elements are the square root of the shared variance between the constructs and their measures.

4.3. Model Fit

Table 4 shows the fit indices for the research model, together with the suggested values. These results manifest that the research model has an acceptable fit over the minimum/maximum limit defined by [96].

Table 4. Goodness of fit statistics.

Fit Indexes	Values	Recommended Value
χ^2 /grade of freedom	0.0206	≤3.00
Normed Fit Index (NFI)	0.966	≥0.90
Non-normed Fit Index (NNFI)	0.981	≥0.90
Comparative Fit Index (CFI)	0.984	≥0.90
Adjusted Goodness-of-Fit Index (AGFI)	0.894	≥0.80
Root Mean Square Error of Approximation (RMSEA)	0.0489	≤0.05
Goodness-of-Fit Index (GFI)	0.918	≥0.90
Incremental Fit Index (IFI)	0.984	≥0.90

4.4. Results of the Structural Equation Model

The structural equations software Lisrel 8.80 was used to test the research model with an estimation method of maximum likelihood [97]. Lisrel fuses factor analysis modeling from psychometric theory with structural equations modeling associated with econometrics [98]. The aim was to evaluate the model based on the significance and effect sizes (β) for each hypothesized path and to explain the variance (R2) for each dependent variable [99,100].

Table 5 shows an abridgment of the findings, evidencing the statistical significance of the defined hypotheses. Specifically, AUTO and REL were significant predictors of PEU (0.32, $p < 0.001$; and 0.415,

$p < 0.001$, respectively), although the relationship between COMP and PEU has not been demonstrated. In a similar way, AUTO (0.276, $p < 0.001$) and REL (0.306, $p < 0.001$) were significantly related to PU. Nevertheless, COMP is not a predictor of PU.

Table 5. Research hypotheses test.

Hypothesis (Path)	Path Coefficient	t-Value ¹	Supported
H1: PEU→PU	0.35	7.196 ***	Yes
H2: PEU→BI	0.197	3.392 ***	Yes
H3: PU→BI	0.742	11.529 ***	Yes
H4: AUTO→PU	0.276	6.007 ***	Yes
H5: AUTO→PEU	0.32	5.513 ***	Yes
H6: REL→PU	0.306	9.411 ***	Yes
H7: REL→PEU	0.415	6.481 ***	Yes
H8: COMP→PU	0.0853	1.950	No
H9: COMP→PEU	0.0973	1.742	No

¹ Significant at: * $p < 0.05$ (t(0.05; ¥) = 1.9670; ** $p < 0.01$; t(0.01; ¥) = 2.5904; *** $p < 0.001$; t(0.001; ¥) = 3.3195.

Furthermore, PEU had a significant positive impact on PU (0.35, $p < 0.001$). Finally, PU (0.742, $p < 0.001$) and PEU (0.197, $p < 0.001$) had a significant positive impact on BI. Considering these results, the percentages of variance explained by the research model for the dependent constructs were as follows: (1) 69.8% for BI, (2) 55% for PEU, and (3) 73.3% for PU.

5. Discussion

OSS, together with all other ICT, has begun to change the way of teaching and learning, offering a viable alternative to proprietary educational technologies. The principal aims of this study were to contribute additional evidence regarding motivations to use OSS for educational and non-educational purposes. The findings revealed a measurement and structural model to predict behavioral intention to use OSS among secondary school graduates who had received mandatory OSS training. In this respect, little research has found empirical support to define best teaching practices in secondary school education in order to motivate ICT use.

In this context, the current study incorporated motivational predictors into OSS acceptance in the educational context. Indeed, it proposed a motivational acceptance model of OSS, combining constructs from SDT (autonomy, relatedness, and competence) with the TAM. This model purports to explain the factors that affect behavioral intention to use OSS in order to help fill the gap in the literature about the acceptance of OSS in the educational field. Some researchers have reported [15] active student attitudes towards the use of OSS in a training context, but motivational factors have been largely neglected. In fact, this study is one of the first to explore the interaction between the basic needs of autonomy, competence, and relatedness, and behavioral intention to use OSS.

Specifically, the research presented here explored the connections between the TAM [32,50] and SDT [54,55]. In recent years, both frameworks have drawn the attention of many researchers in educational literature [38–40,62–64]. Consistent with this growing interest in both theories, this study has investigated the relationship between behavioral intention to use OSS among secondary school graduates from education systems that provide intensive OSS training and the following constructs: perceived ease of use, perceived usefulness, autonomy, relatedness, and competence. Specifically, the combination of these two frameworks was adopted in order to: (1) explore the motivational determinants of student behavior towards OSS; and (2) propose a research model to analyze the effect of self-motivation factors in order to gain a deeper understanding of the relationship between human motivation and technology acceptance.

Findings are in line with previous research. According to [101], it is possible to influence three aspects to stimulate self-determination among students: (1) defining interpersonal connections that accentuate choice and flexibility rather than control and rule; (2) explaining to students in a reasoned

way why certain attitudes are relevant for their well-being; and (3) accepting adverse feelings towards some activities. Applying these three propositions to this current research, students with OSS training will be more inclined to use OSS in any facet of their life because they perceive that it is easy to use or useful. Indeed, according to [56], individuals can improve their optimal functioning and well-being by engaging in activities that interest them.

Thus, the TAM-SDT model defined offers a useful framework to identify the socio-environmental factors affecting the tendency toward self-motivation and to draw conclusions about why people use OSS to fulfill their needs. In fact, the TAM is the most widely used theoretical approach to study the usage intention of technology, although it is limited when the acceptance and use of ICT are also geared towards fulfilling emotional needs [44]. In this context, based on previous SDT research [58,69,73,74], the proposed model includes the most relevant motivational factors of this theory, and several interesting findings emerged.

Overall, the hypotheses, excluding H8 and H9 related to the factor COMP, were supported, and the model attained acceptable fit indices. As expected, based on the studies of [48,90,91], these results highlight the positive influence of AUTO, REL, PEU, and PU on BI towards OSS. In this respect, this study offers evidence that corroborates the all-purpose combined use of SDT and the TAM, and at the same time, supports the relationship between OSS training and motivational models.

Aligned with the postulates of SDT, this study has demonstrated that autonomy enhances perceived usefulness and ease of use. Hence, the sense of autonomy impacts directly on positive behaviors toward OSS use due to its capacity to stimulate voluntary acts, even if they come from external initiatives. In a similar way, collaborations and communications with others can reduce fears and increase the sharing of knowledge related to OSS features. Hence, relatedness has a positive impact on PU and PEU.

6. Conclusions

The findings of this research suggest that intrinsic motivations are crucial for spreading OSS use as an alternative to proprietary software. In this respect, these results emphasize that participating as a student in a training system, in which it is mandatory to use educational software based on OSS, encourages intrinsic motivations, such as autonomy or relatedness. These motivations help activate a positive behavior to continue using OSS, due to an improvement in the perception of this ICT. Bearing this in mind, certain implications and limitations of these findings are described below.

6.1. Implications

It is possible to identify certain implications based on the findings. From an academic point of view, this study further develops knowledge regarding the use and adoption of OSS. Hence, the feasibility of combining the TAM and SDT in order to explain ICT adoption has been demonstrated. Moreover, from a managerial perspective, understanding the behavioral intention to use OSS is meaningful for the OSS movement. In fact, some practical implications can be extracted.

First, a better understanding of the motivations of OSS users could be advantageous for OSS developers in determining which software functionalities encourage OSS expansion. Second, with these findings, the OSS movement might achieve segmentation of users in order to identify behaviors that favor OSS use, and thus can anticipate the success of this type of ICT.

6.2. Limitations

This research is not without limitations. First, some weaknesses have been identified regarding the sample. On the one hand, data collection was performed in secondary schools from a specific region without considering other geographical areas. On the other hand, this study has not applied a stratified sampling procedure, which would have allowed us to recruit equal sizes of age groups or age groups that mirror the current population. Second, the percentage of explained variance for behavioral intention to use could be improved with the incorporation of other predictors associated with other motivational theories. Finally, the findings from this study are limited to OSS use with an

educational purpose. Therefore, it would be helpful to carry out complementary studies that include additional OSS uses.

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Appendix A

Table A1. Questionnaire.

	Items	Source
AUTO1	I fell a sense of choice and freedom using OSS	
AUTO2	OSS education provides me interesting options and choices	[48,90]
AUTO3	I have more control while using OSS	
AUTO4	OSS gives me more chances to control my tasks	
COMP1	I am better in OSS than other users	
COMP2	I have stronger capability than other users thanks OSS	
COMP3	I am superior to others through using OSS	[48,90,91]
COMP4	After receiving an OSS training, I felt competent	
COMP5	I have been able to learn an interesting new skill through OSS	
REL1	I really like the OSS users	
REL2	OSS gives me more chances to interact with others	[90,91]
REL3	I feel close to others while using OSS	
REL4	I have more opportunity to be close to other though OSS	
PEU1	My interaction with OSS solutions is clear and under stable	
PEU2	It is easy for me to become skillful at using OSS	[41,48]
PEU3	I find OSS easy to use	
PU1	Using OSS enhances my effectiveness	
PU2	OSS is useful for my life/job	[41,48]
PU3	Using OSS increases my productivity	
BI1	I indent to use OSS in the future	
BI2	I plan to use OSS in the future	[41,48]
BI3	I predict I would use OSS in the future	

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