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Academic Performance and Technology Acceptance Model (TAM) Through a Flipped Classroom Experience: Training of Future Teachers of Primary Education

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Abstract

In recent years, studies carried out in the educational field have concluded that the Flipped Classroom methodology offers numerous advantages for both teachers and students. In this sense, this approach is worked on at the university to develop skills necessary for the future professional of students, as well as increase their commitment to the subjects. The general objective of this research is to verify if the learning acquired through the Flipped methodology, as well as the perception of it, are useful for university students of the Degree in Primary Education. For this, two types of designs are used: pretest-posttest and validation through structural equations (PLS) of the scale to evaluate the degree of acceptance of the Flipped methodology based on the TAM model. The results show the adequacy of the training proposal based on Flipped methodology for university students. The students perceive the incorporation of the inverted methodology as an adequate strategy, highlighting the ease of use in the classroom, the acceptance of its integration, the transformation of interest in learning and showing a positive attitude towards its use in the future. Together, the level of acceptance as regards the validation of the TAM model is high. Finally, the possibility of replicating the model in similar investigations or through the so-called emerging technologies is evaluated.

Keywords: flipped classroom, digital competence, primary education, teacher training, TAM, CFA

INTRODUCTION

Background

In most of our universities, traditional learning methodologies centered on the teacher and not on the student continue to be used (Garay et al, 2017; Lai et al., 2018; Pelger & Nilsson, 2018; Sánchez-Rodríguez).

Nowadays, Flipped Classroom practices are acquiring a relevant role (Zainuddin et al., 2019). Above all, due to the diversity of possibilities they offer, as the various meta-analyses on the subject are showing (Galindo-Domínguez & Bezanilla, 2019; Sola et al., 2019).

Generally, Flipped Classroom refers to classroom practice in which content is available to the student through various materials for pre-class study; the activities carried out in class are to deepen the understanding of the content (Brewer & Movahedazarhouli, 2018; O’Flaherty & Phillips, 2015). As Mengual-Andrés et al. (2020, p. 78), “is defined as a pedagogical approach in which the traditional roles of the classroom are inverted so that students start their learning outside the traditional classroom and continue, reinforce and complement it in their regular school hours”.

Many of the studies carried out in the studied field conclude that the Flipped Classroom can offer different advantages for both teachers and students. Teachers, for example, allow him to better understand the learning styles and difficulties of students and offer individualized tutoring, as well as taking advantage of class time to understand the contents (Roehl et al., 2013). On the other hand, students are more involved than in traditional classes, provoking positive emotions and attitudes towards learning (Herrera & Prendes, 2019; Monteagudo et al., 2017; Priporas et al., 2017; Rani & Muniandy, 2019; Sosa Díaz & Palau Martín, 2018).

Flipped Classroom: A Student-Centered Method

In Flipped Classroom, the student’s commitment to the teaching-learning process plays a fundamental role (Boekaerts, 2016; Guo, 2018; Lei et al., 2019). Therefore, they must generate an active role in their own learning to acquire the necessary skills for their professional future (Daellenbach, 2018; Fletcher et al., 2017).

Flipped Classroom conforms two types of learning by the student (Bergmann & Sams, 2012). At first there is individual learning, before class, during which students are exposed to learning content through a variety of media formats, such as video and text (Bergmann & Sams, 2012; Mohamed & Lamia, 2018; Sun et al., 2018). A second moment, which focuses on interactive classroom learning, in which students have various types of interactive learning activities, such as questions and answers, explanation of advanced concepts, discussions, problem solving, and collaborative projects (Kim & Park, 2017; Long et al., 2018). Students in a Flipped Classroom go from being passive learners to active learners (Kim & Park, 2017; Sun et al., 2018). Rojas (2020), based on Bloom’s taxonomy for the digital age, points out how the categories that require lower thinking skills (remembering, understanding and applying) can be developed at home. On the other hand, those of a higher order (analyze, evaluate and create) can be developed in the classroom.

The study carried out by Koh (2019) is based on the ideas of student-centered learning; aims to define the four pedagogical dimensions that should exist in Flipped Classrooms in higher education.

- A. Personalization: being student-centered suggests flexibility and choice with learning activities and resources and where teachers use class time to support individual learning needs.
- B. Higher order thinking: as a deep and constructive learning so that the class time that was originally used for the transmission of the topic is now focused on activities that promote critical or higher order thinking of the students.
- C. Self-direction: supports student autonomy, but in turn requires students to take more responsibility for learning.
- D. Collaboration: students have a greater interest in the learning processes of student-centered classrooms and in collaboration through group work.

Teaching-Learning and the Importance of Materials in Flipped Classroom

If we focus on the didactic act, the teacher is a crucial element in making decisions about how the teaching-learning process will be (Ruiz et al., 2020). Studies focused on higher education teachers and their perceptions on the use of the Flipped Classroom are scarce (Abeysekera & Dawson, 2015). Most of the recent

research on the Flipped Classroom focuses on students' experiences, attitudes, and perceptions regarding their learning in the Flipped Classroom (Long et al., 2017; Lopes & Soares, 2018), but not on the teacher. However, all educational innovations are led by a teacher and it is they who make the decisions to adopt the innovations and implement them.

Another of the fundamental elements is that of the materials designed and selected by the teachers (He et al., 2016; Hung, 2015; O'Flaherty & Phillips, 2015). Their role is key to promoting optimal learning experiences with the "Flipped Class" (Van Wyk, 2019). As Hung (2015) points out, the preparation and curriculum design of materials before class is essential for students to be motivated and to be able to get involved and achieve more satisfactory results. In this aspect, it is where one of its limitations appears for its incorporation into educational practice (Recio et al., 2020). Generally, there is a lack of teacher training, both for its use and in the domain of teaching digital skills that enable them to design the technological resources to be used (Cabero-Almenara et al., 2020a, 2020b; Guillén-Gámez et al., 2021, 2020; López et al., 2019; Pozo et al., 2020). This is because the materials to be handled must have specific characteristics of time, structure and technologies (Zainuddin & Attaran, 2016).

Most of the studies that refer to technologies used in the Flipped Classroom have almost always referred to videos. Murillo et al. (2019) point out that the use (and empirical evidence) of said online videos together with mobile devices, social networks and cloud computing applications during the entire teaching-learning process in the Flipped Classroom is one of the greatest benefits provided by this methodology. Findlay-Thompson and Mombourquette (2014) point to the Flipped Classroom as a teaching model in which students watch lectures outside of class time using different forms of technology, such as prerecorded videos, with the aim of creating a collaborative learning environment.

However, it must be recognized that other technologies are increasingly being incorporated into this teaching strategy, such as augmented reality (Sánchez-García & Toledo-Morales, 2017), social networks (Blasco-Serrano et al., 2018), or gamification (Gómez-Carrasco et al., 2019).

Although some studies have not detected a significant difference in student academic performance between inverted and traditional instructional models (Blair et al., 2016; Davis et al., 2013), it should be noted that the vast majority who have analyzed the significance of this variable has revealed the improvement in performance compared to the traditional face-to-face model (Fuentes et al., 2020; Hinojoso et al., 2020; Long et al., 2016; Luo et al., 2018; Torrecilla, 2018; Torrecilla & García, 2020). However, many members of the educational community are still hesitant or reluctant to adopt the Flipped Classroom method, as there are numerous factors that can make the change from a traditional environment to a Flipped Classroom method a frustrating process (DeLozier & Rhodes, 2016; Luo et al., 2018; O'Flaherty & Phillips, 2015).

Due to the lack of conclusive findings, more empirical evidence is needed on the effect of the Flipped Classroom on academic performance and student satisfaction (Chuang et al., 2018; Luo et al., 2018; O'Flaherty & Phillips, 2015). The studies carried out by O'Flaherty and Phillips (2015), and DeLozier and Rhodes (2017) presented direct evidence on how academic performance and satisfaction with student training could be positively affected with a Flipped Classroom compared to a traditional method.

Finally, we understand the general satisfaction level of the students as a positive affective state that results from the evaluation of the teacher, the module and the capacity of the teaching and learning method for a better understanding than the traditional approach centered on the student (Awidi & Paynter, 2019).

Benefits and Difficulties of the Flipped Classroom as a Teaching-Learning Strategy

The Flipped Classroom has proven to be effective in terms of acquiring knowledge and skills for the professional future of students (Gerstein & Friedman, 2016; Lopes & Soares, 2018). Focusing on the relationship between activity-based learning and the Flipped Classroom, Schwarzenberg et al. (2018) observe that the Flipped Classroom increases instructional opportunities among peers when classroom activities promote active learning. All of this helps reduce the effects of prior knowledge on individual students. For this reason, the flexibility it offers when organizing the student's time has been considered a fundamental

element for the success of the Flipped Classroom, giving them the time they need to carry out the different activities and thus be able to better understand the content of the course (Kim et al., 2014; O’Flaherty & Phillips, 2015; Wanner & Palmer, 2015).

According to Tomás et al. (2019) the potential benefits of a Flipped Classroom are tempered by two main concerns: (a) considerable work is required to create and coordinate learning materials and activities, particularly quality Flipped videos, and (b) students may resist to do required work at home and come to class unprepared to participate in planned activities (Herreid & Schiller, 2013; Milman, 2012). Furthermore, the idea that online videos do not offer enough scaffolding for some students is reinforced, as they cannot ask questions to clarify their ideas in real time (Howitt & Pegrum, 2015). For this reason, effective teaching for learning requires students to engage in critical thinking to address complex issues (Wals et al., 2014). However, most cases reflect that students have limited customization of learning options and structured collaboration processes are rarely used, apart from the few cases that implement team learning (Koh, 2019). Research carried out has shown that its incorporation into teaching improves relations between students and teachers (García-Gil & Cremades-Andreu, 2019). The exhaustive analysis of the term “Flipped” by Sánchez-Rodríguez et al. (2017) is remarkable. Their study concludes stating that there are significant benefits with the application of flipped classes, from allowing teachers to identify concepts that their students do not understand, to dedicating time in class to the development of higher order cognitive skills of students. Otro estudio similar es el llevado a cabo por Judy Doru et al. (2020) in a mathematics course for 374 undergraduate Computer Science students. The most significant results indicate that both collaboration and problem solving are enhanced during the Flipped Classroom time.

Finally, it should be noted that, although many studies have investigated the specific activities and practices used in the Flipped Classroom (Chuang et al., 2018; Luo et al., 2018), not enough attention has been paid to the final result of themselves, nor to the satisfaction of the students. In this sense, the Technology Acceptance Model (TAM) becomes an excellent tool to answer this question. In a related study, Bervell and Naufal Umar (2017) evaluate a variant of this model, the Unified Theory of Acceptance and Use of Technology (UTAUT), combined based on linear and non-linear relationships. The results conclude that different societies and cultural contexts produce different behavioral outcomes. Therefore, and as it is intended in this study, models are suitable for evaluating specific learning contexts.

TAM Model for the Analysis of the Acceptance of Emerging Methodologies

To analyze the degree of acceptance of the Flipped Classroom methodology in this study, one of the most significant models is used to explain the degree of adoption that a person makes of a technology, both general and specific. This model was originally called Technology Acceptance Model (TAM), by Davis (1989). Under its umbrella it is collected that the beliefs, attitudes or predispositions that are had about the technologies will have repercussions on the use that is made of it. To do this, it is determined by two variables: perceived usefulness and perceived ease of use. The TAM model proposes and empirically demonstrates that the Perceived Utility (UP), Perceived Ease of Use (FUP), Perception of Enjoyment (PD), Attitude Toward Use (ACU) and Intent to Use (UI) are the most critical factors in the process of technology adoption and the use of systems (Chen & Tan, 2004).

Different transformations have been incorporated in different studies (Cabero-Almenara et al., 2016; Cabero-Almenara & Llorente-Cejudo, 2020; López-Bonilla & López-Bonilla, 2017). This has been done through the incorporation of new dimensions such as, for example, predictive dimensions (gender, degree of obligation to adopt the technology, experience, age, type of users, etc.). One of these cases is the study carried out by Cabero-Almenara et al. (2018b). In it, two aspects are revealed: first, the validity and consistency of the TAM model, and secondly, its significance for determining the future degree of acceptance of virtual training. This last fact will determine the significance that virtual training can acquire in a training institution.

From the model itself, it is emphasized that it must be built in each and every situation of acceptance of the technologies to be investigated. For this reason, it is exceptionally adapted to the study presented, contextualizing and locating in it the mediating variables that are considered from the researcher’s point of view. In this sense, the model has evolved towards other versions, such as TAM 2 (Venkatesh & Davis, 2000),

the Unified Theory of Acceptance and Use of Technology (Bervell & Naufal Umar, 2017; Venkatesh et al. 2003), or the integration model of acceptance of technology and user satisfaction (Venkatesh & Bala, 2008).

For the TAM application model in Flipped methodologies, the following modifications are made: a) the number of mediating variables is expanded; and b) incorporation of the variables gender, age, technical domain that the person who has the technologies could consider.

METHODOLOGY

Objectives

The general objective of the study is to verify whether the learning acquired through the Flipped methodology, as well as the perception of it, are useful for students. Likewise, the study raises the following specific objectives:

- O1. Check the adequacy of the training proposal based on Flipped methodology for teachers in Primary Education training.
 - O1.1. Check if there are statistically significant differences between the correct answers obtained in the pretest and posttest for the 2 subjects and in a general way.
 - O1.2. Check if there are statistically significant differences between the errors obtained in the pretest and posttest for the 2 subjects and in general.
- O2. Study the level of acceptance of the Flipped methodology of teachers in Primary Education training:
 - O2.1. Validation of the Flipped Methodology Acceptance Model (TAM).
 - O2.2. Analysis of the level of acceptance of the Flipped methodology.

Design

The present study uses two types of designs: pretest-posttest and scale validation with descriptive. The first of these, pretest-posttest, is “one of the most used quasi-experimental designs in educational research” (Cohen et al., 2007, p. 283). In this case, it is a question of checking if there are differences in the student’s competence level before and after receiving the training through Flipped Classroom. To do this, a contrast study is carried out on two knowledge questionnaires: “General principles for the use, design and evaluation of media” and “Video in teaching”. Regarding the validation of the scale, it is about validating the acceptance scale of the Flipped methodology by adapting the TAM model of Davis (1989). Subsequently, we proceed to provide the most significant data related to the acceptance of the Flipped methodology.

Participants

All the participants are first-year students of the Primary Education Degree who take the subject of ICT applied to Education. A total of 129 students; 94 women (72.9%) and 35 men (27.1%) who voluntarily participated in this study. Despite the significantly lower number of male participants, the sample was considered acceptable, as this gender ratio is typical for ICT-focused Primary Education, Primary and Pedagogy subjects, and a balanced sample would have been too small or unreachable.

Experience Procedure

The experience carried out in the subject of Technologies applied to Education in the Primary Degree is presented, which is taught in the first year at the Faculty of Education Sciences of the University of Seville. Two subjects of the subject have been worked with inverted methodology (Flipped Classroom) and the rest through their usual programming.

It takes place during the months of February to March 2020, more specifically, from February 12 to March 11. Next, a specific timing for the development of the experience is generated by the teachers involved in

Table 1. Timing and structure of the development of the experience

| Date | Monday | Rest of the week |
|----------------|---|------------------|
| February 12-23 | Presentation Material T.1 PRETEST | Individual work |
| March 26-2 | Platform Material Delivery | Team work |
| March 5-9 | POSTEST T.1 Presentation Material T.2 PRETEST | Individual work |
| March 12-16 | Platform Material Delivery | Team work |

the study. Its objective is to minimize the possible external variables that may be generated as much as possible.

For this and, so that all the groups involved follow the same pattern, students are also offered a series of guidelines.

1. Preparation of materials, preparation of the presentation / motivation sheet.
 - a. The first day it is necessary to explain what the methodology consists of, what structure will be followed, what evaluation it will have, and motivate them in a general way to participate.
2. Outside the classroom: individual work by students and completion of the questionnaire by students.
 - a. The pre-test is completed.
 - b. Students, for each of the topics, will be given a document with a video clip (polymedia) and two texts, where they are clearly explained what they have to do with the materials, the importance of that topic, and how you should work them.
 - c. Students have to generate an individual report on the understanding of the materials, and deliver them before the group work session.
3. In the classroom:
 - a. Clarification of the teacher of the possible doubts raised.
 - b. Student work to carry out an activity.
 - c. Delivery of activities.
 - d. The post-test is completed.

Finally, to verify the degree of motivation and level of satisfaction that university students arouse by participating in training experiences supported by technological tools with this Flipped Classroom methodology and inquire about technical, curricular and organizational difficulties, the TAM (Davis, 1989). Its application was carried out electronically through the following address: <https://cutt.ly/KgOCw0S>

Data Analysis Procedure

Before analyzing the data, it has been found that these are not normally distributed through the study of asymmetry and kurtosis. The "Kolmogorov-Smirnov goodness of fit" test has confirmed this verification, with significance (p-value) equal to .000 for all items (non-normal distribution).

To check if there are statistically significant differences between the pretest and posttest, a contrast design is applied using the Wilcoxon signed rank test for related samples and calculation of the effect size using Cohen's D (O1.1, O1.2).

After that, to reach O2.1, the inverted methodology acceptance model (TAM-Flipped) is validated through an analysis of reliability (Cronbach's Alpha and composite reliability), construct validity (AVE) and modeling of structural equations (PLS). After that, descriptive and central tendency analyzes (O2.2) are carried out.

Table 2. Rank analysis and rank test with Wilcoxon sign and effect size: posttest-pretest correct answers

| | Ranks | Average range | Sum of ranges | Z | Sig. | Cohen's D |
|--------------------|-----------------|---------------|---------------|--------|-------|-----------|
| DESIGN TOPIC (T.1) | Negative ranges | 37.44 | 973.50 | -4.884 | 0.000 | 0.69 |
| | Positive ranges | 51.98 | 3586.50 | | | |
| VIDEO TOPIC (T.2) | Negative ranges | 45.60 | 2097.50 | -1.170 | 0.000 | 0.59 |
| | Positive ranges | 52.95 | 2753.50 | | | |
| GENERAL | Negative ranges | 48.55 | 1845.00 | -4.276 | 0.000 | 0.64 |
| | Positive ranges | 63.35 | 4941.00 | | | |

Table 3. Rank analysis and Wilcoxon signed rank test and effect size: posttest-pretest errors

| | Ranks | Average range | Sum of ranges | Z | Sig. | Cohen's D |
|--------------------|-----------------|---------------|---------------|--------|-------|-----------|
| DESIGN TOPIC (T.1) | Negative ranges | 54.54 | 4799.50 | -7.571 | 0.000 | 1.19 |
| | Positive ranges | 27.04 | 351.50 | | | |
| VIDEO TOPIC (T.2) | Negative ranges | 55.98 | 3695.00 | -3.591 | 0.000 | 0.58 |
| | Positive ranges | 43.28 | 1558.00 | | | |
| GENERAL | Negative ranges | 66.49 | 6317.00 | -7.297 | 0.000 | 0.89 |
| | Positive ranges | 34.29 | 823.00 | | | |

The data obtained are analyzed with the statistical package SPSS 23 (descriptive analysis and contrast), and SmartPLS 3 software (modeling structural equations).

RESULTS

It begins by checking the adequacy of the training proposal based on inverted methodology (O1). First, it is studied whether there are statistically significant differences between the correct answers obtained in the pretest and posttest for the 2 subjects and in general (O.1.1). To do this, we proceed to apply the Wilcoxon signed rank test and calculate the effect size. The results appear in **Table 2**.

As can be seen, the results show significant values for both tests and in a general way (sig. = 0.00 < 0.05). Therefore, it can be stated with 99% confidence that there are statistically significant differences between the level of knowledge demonstrated by the students before and after the development of both topics using the Flipped methodology. In this case, taking into account the analysis of the average range, it is observed that after the development of the topics, the level of knowledge is higher. Specifically, after reviewing the values of Cohen's D (effect size), it can be stated that the differences are large (Cohen, 1988).

Next, it is a question of checking whether there are statistically significant differences between the errors obtained in the pretest and posttest for the 2 subjects and in a general way (O2.2). The tests applied are the same as in the previous case. The results are shown in **Table 3**.

Again, the results reveal significant values for both tests and in a general way (sig. = 0.00 < 0.05). It can be stated with 99% confidence that there are statistically significant differences between the level of error demonstrated by the students before and after the development of both topics using the Flipped methodology. In this case, taking into account the analysis of the average range, it is observed that after the development of the topics, the level of error decreases. Specifically, after reviewing the values of Cohen's D (1988), it can be stated that the differences are moderately large (video theme) or very large (design theme, and in general).

After having verified the adequacy of the training proposal, we proceed to study the level of acceptance of the inverted methodology (O2). In this case, an adaptation of the technology acceptance model (TAM) suggested by Davis (1988) for the Flipped methodology is created. For this reason, before describing the data, we proceed to validate the adaptation made (O2.1).

First, the reliability and construct validity values are shown. In the case of validity, the global result after applying Cronbach's Alpha is 0.928. According to O'Dwyer and Bernauer (2013), this figure implies a high

Table 4. Values of reliability and validity of construct by dimensions

| | Cronbach's alpha | Composite reliability | Mean extracted variance (AVE) |
|-----|------------------|-----------------------|-------------------------------|
| UP | 0.918 | 0.942 | 0.802 |
| FUP | 0.810 | 0.883 | 0.717 |
| PD | 0.920 | 0.950 | 0.864 |
| ACU | 0.803 | 0.910 | 0.835 |
| IU | 0.856 | 0.993 | 0.874 |

Table 5. Discriminant validity of the model using the Fornell-Larcker criterion

| | ACU | FU | IU | PD | UP |
|-----|-------|-------|-------|-------|-------|
| ACU | 0.914 | | | | |
| FU | 0.361 | 0.846 | | | |
| IU | 0.783 | 0.286 | 0.935 | | |
| PD | 0.780 | 0.290 | 0.638 | 0.929 | |
| UP | 0.719 | 0.409 | 0.702 | 0.599 | 0.896 |

Table 6. Load model crosses

| | UP | FUP | PD | ACU | IU |
|------|-------|-------|-------|-------|-------|
| UP1 | 0.906 | | | | |
| UP2 | 0.857 | | | | |
| UP3 | 0.906 | | | | |
| UP4 | 0.912 | | | | |
| FUP1 | | 0.828 | | | |
| FUP2 | | 0.793 | | | |
| FUP3 | | 0.914 | | | |
| PD1 | | | 0.959 | | |
| PD2 | | | 0.956 | | |
| PD3 | | | 0.871 | | |
| ACU1 | | | | 0.909 | |
| ACU2 | | | | 0.919 | |
| IU1 | | | | | 0.932 |
| IU2 | | | | | 0.938 |

level of reliability. Together, we proceed to calculate the indices of reliability, composite reliability and construct validity by dimensions. The results are shown in **Table 4**.

As can be seen, all the relative reliability results (Alpha and composite reliability) are greater than 0.7, an adequate minimum value according to Lévy (2006) to indicate acceptable levels. Therefore, it can be stated that the proposed model for the acceptance of the Flipped methodology presents good internal consistency in terms of its block of indicators. Regarding convergent validity, all the indices of mean variance extracted (AVE) are greater than 0.5. This value is taken as a reference by Bagozzi and Yi (1988) to indicate that more than 50% of the construct variances are due to the model indicators. Therefore, it can be stated that the total amount of the variance of the indicators is taken into account by the latent construct.

After that, the discriminant validity of the model is analyzed, which allows us to know if each dimension is different from the others. For this, two techniques are used: the Fornell-Larcker criterion and analysis of the cross loads.

The Fornell-Larcker criterion allows us to check whether the mean extracted variance of a dimension is greater than the variance of the rest of the dimensions. The results are shown in **Table 5**.

To interpret this table, it must be taken into account that the elements of the diagonal are the square root of the mean extracted variance, and the others the correlations between dimensions. As you can see, all the values that are to the left and below the values of the diagonal are less than them. Therefore, the first criterion of discriminant validity is confirmed.

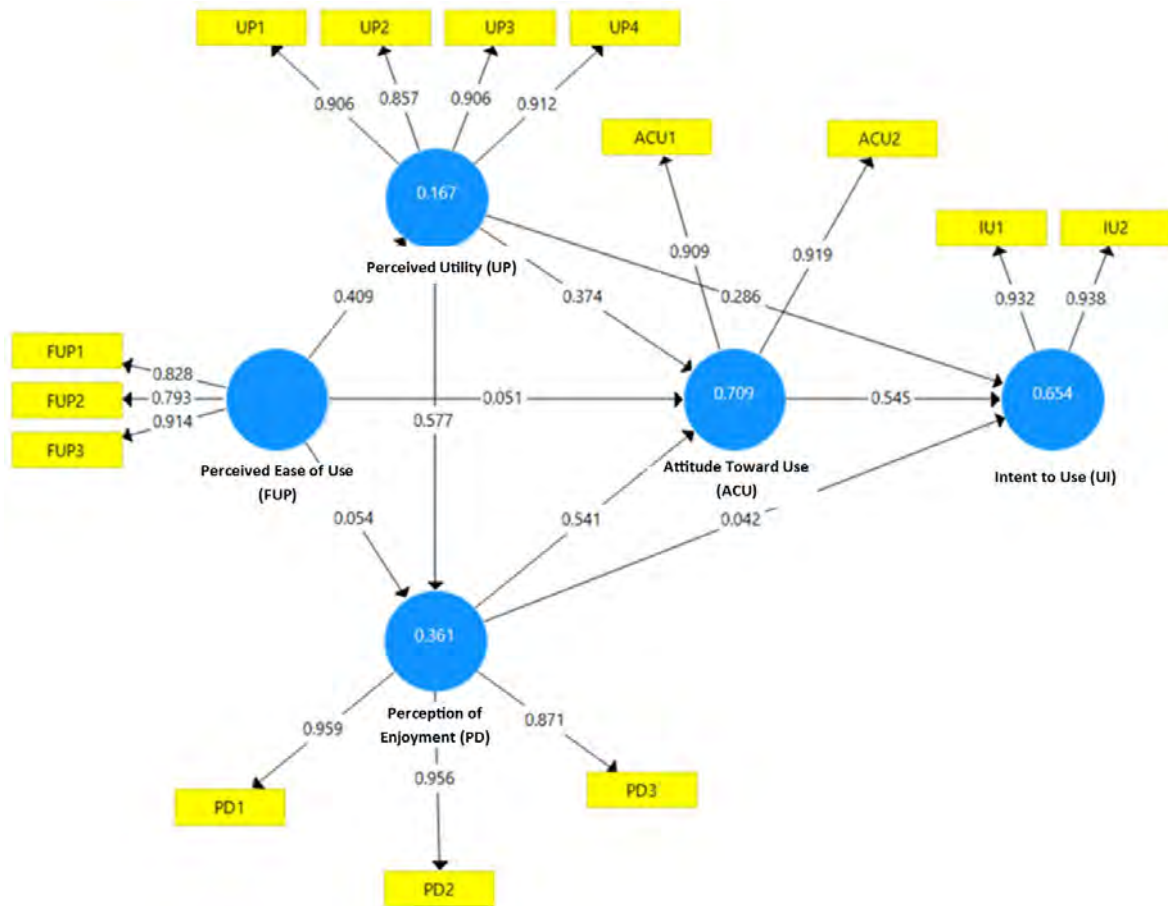


Figure 1. Structural model (TAM-Flipped)

Table 7. Student’s t-values and p-values of the path coefficients

| Item-Dimension | Original sample | Sample mean | SD | T | P values |
|----------------|-----------------|-------------|-------|--------|----------|
| UP1-UP | 0.299 | 0.298 | 0.14 | 20.629 | 0.000 |
| UP2-UP | 0.229 | 0.227 | 0.023 | 10.022 | 0.000 |
| UP3-UP | 0.296 | 0.297 | 0.017 | 16.972 | 0.000 |
| UP4-UP | 0.291 | 0.292 | 0.015 | 19.429 | 0.000 |
| FUP1-FUP | 0.332 | 0.326 | 0.073 | 4.544 | 0.000 |
| FUP2-FUP | 0.287 | 0.279 | 0.078 | 3.655 | 0.000 |
| FUP3-FUP | 0.544 | 0.556 | 0.089 | 6.103 | 0.000 |
| PD1-PD | 0.368 | 0.368 | 0.009 | 39.413 | 0.000 |
| PD2-PD | 0.372 | 0.373 | 0.011 | 32.547 | 0.000 |
| PD3-PD | 0.335 | 0.334 | 0.015 | 21.688 | 0.000 |
| ACU1-ACU | 0.532 | 0.532 | 0.014 | 37.567 | 0.000 |
| ACU2-ACU | 0.562 | 0.561 | 0.019 | 30.300 | 0.000 |
| IU1-IU | 0.522 | 0.523 | 0.014 | 36.747 | 0.000 |
| IU2-IU | 0.548 | 0.547 | 0.017 | 31.327 | 0.000 |

The results, higher than 0.7, indicate high levels of correlation (O’Dwyer & Bernauer, 2013). Therefore, it is ensured that the items measure the construct to which they have been incorporated.

After that, the formulated model is presented by obtaining the standardized regression coefficients (path coefficients), the student’s t values and the R² (R-squared) of the structural diagram (Figure 1).

Regarding the results, the model explains 71% of the variance in the dimension “Attitude Towards Use”, 65% in the dimension “Intention to Use”, 36% in the dimension “Perception of Enjoyment” and 18% in the “Perceived Utility” dimension. Table 7 represents the t-values and standardized regression coefficients, as well as the significance of the model after using the bootstrap technique.

Table 8. Model fit

| Indicator | Result | Reference |
|------------|---------|-----------|
| SRMR | 0.072 | <0,08 |
| Chi-square | 252.995 | <500 |
| NFI | 0.792 | >0.7 |

Table 9. Descriptive statistics of the level of acceptance of the inverted methodology (items)

| Item | Mean | SD |
|---|------|------|
| The use of this methodology I think could improve my learning in the classroom (UP1). | 5.04 | 1.12 |
| The use of this methodology during the classes makes it easier for me to understand certain concepts (UP2). | 4.81 | 1.38 |
| I think this methodology is useful when learning (UP3). | 5.16 | 1.11 |
| The use of this methodology favors my learning (UP4). | 4.93 | 1.29 |
| I think the methodology is easy to use (FUP1). | 5.49 | 1.11 |
| Learning to use and deal with it has not been a problem for me (FUP2). | 5.36 | 1.31 |
| Learning to use and handle it with this methodology has been clear and understandable to me (FUP3). | 5.19 | 1.18 |
| Using it has been fun for me (PD1). | 4.61 | 1.42 |
| I enjoyed using this methodology (PD2). | 4.66 | 1.37 |
| I believe that the methodology allows to learn while playing (PD3). | 4.67 | 1.54 |
| The use of this methodology makes learning more interesting (ACU1). | 5.02 | 1.22 |
| I think its use in the classroom is a good idea (ACU2). | 5.36 | 1.15 |
| I would like to use this methodology in the future if I have the opportunity (IU1). | 5.19 | 1.35 |
| I would like to use this methodology to learn both the topics that have been presented to me and with other topics (IU2). | 4.98 | 1.44 |

Table 10. Descriptive statistics of the level of acceptance of the inverted methodology (dimensions and total)

| Dimension | Mean | SD |
|------------------------------|------|------|
| Perceived utility (UP) | 4.98 | 1.09 |
| Perceived ease of use (FUP) | 5.34 | 1.01 |
| Perception of enjoyment (PD) | 4.65 | 1.33 |
| Attitude towards use (ACU) | 5.19 | 1.10 |
| Intent to use (UI) | 5.19 | 1.35 |
| Total | 5.07 | 0.94 |

As can be seen, all the relationships in the model are significant with a confidence level of 99%.

Finally, the goodness of fit of the model is evaluated using the standardized square mean square (SRMR), Chi-square and normalized fit index (NFI). **Table 8** shows the values obtained, as well as the reference values according to Hu and Bentler (1999).

After validation of the proposed model, an analysis of the level of acceptance of the inverted methodology (O2.2) is carried out. **Table 9** shows the means and standard deviations of each of the items that make up the model. For its interpretation, it must be taken into account that the scale used has 7 points (1 = Totally disagree / 7 = Totally agree).

All items are above 4.6 points. This implies that, in general, the level of acceptance of the Flipped methodology is moderately high. Specifically, it stands out: ease of use in the classroom (FUP1, FUP2 and FUP3), acceptance of their integration (ACU2), transformation of interest in learning (ACU1) and positive attitude towards its use in the future (IU1).

To specify the analysis, a descriptive analysis by dimensions is carried out. The results can be seen in **Table 10**.

As can be seen, the students highlight the ease of use (FUP) and show a positive attitude and intention towards its use (ACU and IU).

DISCUSSION

The Inverted Classroom methodology is a strategy that is being presented as truly useful and with a great variety of possibilities to facilitate learning by students in different curricular areas and at different educational levels, from kindergarten to university. However, it must be taken into account that considerable efforts are being made to carry out studies and research with the aim of knowing in depth how students learn through it.

The present work has focused on this line. For this, one of the models that is presented as significant in the scientific literature is the TAM, formulated by Davis (1989). This model suggests that the perceived usefulness of a technology and its perceived ease of use will establish values regarding the attitude of use of the same by the subject that will direct it towards a specific intention of use. When it was established to carry out an analysis of the level of acceptance of the inverted methodology through two thematic blocks in the subject of Information and Communication Technologies of the Primary Education Degree (O2.2), the results lead to establish one of the first conclusions; The students perceive the incorporation of the inverted methodology as an adequate strategy, highlighting the ease of use in the classroom, the acceptance of its integration, the transformation of interest in learning, and showing a positive attitude towards its use in the future. With all this, it can be affirmed that the training received by the students who have participated in this learning experience has developed satisfactorily.

On the other hand, another of the conclusions that can be derived from this study is that the level of acceptance regarding the validation of the TAM model is high (Teo et al., 2009; Venkatesh & Bala, 2008). This model presents adequate internal consistency with regard to the block of indicators (Cabero-Almenara et al., 2018b). Therefore, the TAM model used is presented as a good predictor to explain the attitude towards the Flipped Classroom methodology in university education. All this highlights the significance of the model initially formulated by Davis (1989). In this sense, the results obtained are very much in the same line as those achieved by Arteaga and Duarte (2010), or Cabero-Almenara et al. (2018a).

CONCLUSION

Based on the specific objective of this study, where the need to verify the adequacy of the proposal on the performance tests carried out on students is raised, one of the first conclusions that can be reached with the data obtained is that the methodology of the Flipped learning is adequate in acquiring concepts and knowledge of specific topics. Together, it presents large differences between the scores achieved by the students in the successes of the performance tests before and after having carried out the action.

Likewise, when the verification is carried out based on the data of the academic performance obtained based on the errors, they showed in the same way that the differences in both subjects (Design and Video) in which a Flipped learning methodology was applied, the differences were moderately high. In this sense, it could be concluded that it is proven that the Flipped methodology has a significant effect on the increase in learning by students in a general way, both with regard to the correct answers obtained through the pretest-posttest, as well as the decrease in the number of errors in them.

Finally, it would be interesting to replicate the model in studies and research, but with the application of different methodologies, such as, for example, the Scape-Room, since it also has a high educational potential, or through the incorporation of different technologies, especially, through the so-called emerging technologies or gamification methodologies.

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