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Analysis of Information and Communication Technologies and Flipped Classroom Methodology to Motivate Freshmen University Students[1]

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Abstract

In Spain, low motivation is one of the reasons freshman students allege to explain their dropping out from higher education degrees. Hence, this study analyses the impact of different educational resources and tools supported by Information and Communication Technologies (ICT) on the motivation of students in the freshman year of three Bachelor´s Degrees in the University of the Basque Country. With such aim, interactive activities were implemented in two undergraduate courses: Natural Sciences in Primary Education I (NSPEI) of the 'Bachelor´s Degree in Primary Education'; and Chemistry (CH), of both 'Bachelor´s Degree in Marine Studies' and 'Bachelor's Degree in Nautical Studies and Maritime Transport'. Motivation has been modelled according to: the importance a person awards to an activity, the expectations put on it, the belief of the usefulness of the result and the fast reward in the response. The sorting in tool valuations reported in the final questionnaire by NSEPI students generally met the order in the motivation values predicted by the Vroom model. Regarding the final questionnaire, in general, students believe that ICTs are essential, but that they do not replace traditional educational resources. It is remarkable that NSEPI students have a better perception than CH students of ICT tools, probably because they will most certainly implement them in their future professional activity.

INTRODUCTION

Motivation is a key element in learning since when a person is motivated, he or she will be much more involved in academic activities (Ramos, 2014). This implication is important to optimize the performance of the teaching-learning process (Ajello, 2003), particularly in the freshman year of a Bachelor's Degree, in which each student must achieve a minimum percentage of credits to continue with their studies. Such is the case of the Bachelor's Degrees in the University of the Basque Country (UPV/ EHU) (BOPV 2014) to which the undergraduate courses target of this study correspond: Natural Sciences in the Primary Education Classroom I (NSPEI) (Bachelor´s Degree in Primary Education) and Chemistry (CH) (Bachelor´s Degree in Marine Studies and Bachelor´s Degree in Nautical Studies and Maritime Transport). The general characteristics of such undergraduate courses are shown in Table 1.

Table 1. Features of the undergraduate courses studied in the 2019/20 academic year (University of the Basque Country UPV/ EHU, 2019)

Course	ECTS	Bachelors' Degree in	Cut-off mark (over 14)	Number of enrolled students	Male/female/non-binary (%)	Half	Situation
Nature Sciences in Primary Education I	6	Primary Education	9.3	50	33.0/77.0/-	2nd	Alarm status due to COVID 19 pandemic
Chemistry	6	Marine Studies	-	20	100.0/-/-	1st	Usual
		Nautical Studies and Maritime Transport	-	24	88.5/12.5/-		

According to data from the Spanish Ministry of Science, Innovation and Universities (2018), the dropout rate in the freshman year 2014-2015 reached 21.5 %. In other words, almost 1 in 4 freshmen students dropped out. Regarding the Bachelor's Degrees object of this study, the dropout rate for freshmen students in the 2017-2018 academic year widely fluctuated around the aforementioned average value. Namely, it was as much as 33.0 % in the Bachelor's Degree in Nautical Studies and Maritime Transport, and 11.1 % and 8.6 % in the Bachelor's Degree in Marine Studies and the Bachelor's Degree in Primary Education, respectively. According to a report on student dropping out of the University of Jaén (2015), the need to achieve a minimum number of credits was the most frequently stated reason (30%) by those students who dropped out of a Bachelor's Degree of this university during the freshman year, followed by economic reasons (12%). Among the remaining causes addressed in the report, the following most cited was motivation. Hence, upon dropping out of the degree, 11 % of the students interviewed claimed that initial expectations were not met, and 8 % of them reported they had lost interest or motivation.

Bearing in mind the importance of motivation among the students interviewed, this paper will be focused on the way in which 1st grade professors can influence students by increasing their motivation through different educational resources and tools supported by Information and Communication Technologies (ICT).

From a cognitive approach, motivation can be modelled according to Vroom's expectancy-value theory (1964). This theory is based on the assumption that individuals will take action when they believe their efforts will lead to a successful performance, bringing them positive results. This model is represented by the following equation:

$$M = V \cdot E \cdot I \qquad \text{(Equation 1)}$$

Where 'M' stands for motivation, 'V' is the value or level of importance that a person awards to an activity (i.e., the desire or interest they hold when making it), 'E' is the course expectation or probability that effort leads to a result, and 'I' is an instrumentality, that is, the belief of the usefulness of the result to be obtained. On the other hand, from a behavioural perspective, different factors need to be taken into account for reinforcement to be positive, such as the delay

of the reward (DR) (Naranjo, 2004), which is inversely proportional to motivation. By incorporating this variable into equation 1, equation 2 is obtained:

$$M = V \cdot E \cdot I/DR \quad \text{(Equation 2)}$$

The performance of professors might promote student motivation. For example, value (V) can be improved by helping students to find the usefulness of learning in their daily life and/or in designing tools that increase the value of the activity in the total mark of the course. Regarding expectation (E), professors can try to strengthen the confidence of students in their skills to succeed by letting them lead the teaching-learning process (International University of Valencia, 2015), and by providing the means for their self-assessment (Calatayud, 2008).

In such a sense, Flipped Classroom approaches might be helpful for students to play the main role in their learning process since they remove the traditional transmissive lecture and replace it with active in-class tasks and pre-/post-classwork (Abeysekera & Dawson, 2015; Seery, 2015). Besides, a Flipped Classroom course can be taught in various physical facilities, not only in a traditional lecture hall, but also in technology-enhanced classrooms, studios, laboratories, computer labs, meeting rooms, outdoor settings, or online learning spaces (Long et al. 2017). In fact, Nouri (2016) found out that the majority of a BSc degree students who participated in the Flipped Classroom methodology had a positive attitude towards it and, in comparison to those who did not, the students that followed such methodology showed higher motivation and self-sufficiency (Aşıksoy & Özdamlı, 2016). However, as Sáiz Manzanares and Arnaiz-González (2017) report, students considered Flipped Classroom facilitated conceptual construction, butt it could not entirely replace traditional face-to-face lectures. Such statement coheres with the work by van Alen et al. (2019) who found that students in Flipped Classrooms achieved higher learning outcomes when the face-to-face class time was not reduced, or when quizzes were added in the Flipped Classrooms. In fact, quizzes can be a means for students´ self-assessment, which is also an ideal tool to deal with the diversity of first-year students (people with different skills, learning styles, cognitive strategies, previous experiences and knowledge, motivation, attention, emotional and social adjustment, etc.).

Finally, by decreasing the reward delay, such as by publishing the test or activity results once these have ended, the demand for the reward (DR) will decrease and the motivation will thus increase (Eq. 1). In this sense, as pointed out by the International University of Valencia (2015), the use of ICT can be a very useful tool for professors to increase the motivation of students. That might be one of the reasons for which the educational model of the UPV/EHU, approved in 2010 under the IKD name, and followed since 2016 by the IKD i^3 strategy, promotes the use of active and innovative teaching methodologies (UPV/ EHU, 2020). Since 2010, the UPV/ EHU has thus implemented a number of institutional programmes to foster active and innovative methodologies such as Flipped Classroom and ICT, which the authors of this work have joined. Hence, within such a frame, the objective of this work is to evaluate the effectiveness of Flipped Classrooms and ICT to arouse motivation in students.

METHOD

The activities and methodologies were implemented within the framework of the courses NSPEI and CH, which are correspondingly comprehended in the freshman years of the Bachelor's Degree in Primary Education and the Bachelor's Degree in Marine Studies and Nautical Science and Maritime Transport (Table 1). Some of the features of each course and the tools, methodologies and activities implemented are described below. Then, the motivation is quantified on the terms described in equation 2 for each undergraduate course and Bachelor's

Degree. Students at the NSPEI and CH groups underwent two questionnaires about their opinion of the usability of the ICT tools: an initial one before the lessons started and then a final one towards the end of the programme.

Natural Sciences in Primary Education I (NSPEI)

NSPEI is a first-year course of the Primary Education Bachelor's Degree of the Education Faculty of Bilbao. In the 2019-2020 academic year the number of places available was 150 and the cut-off mark was 9.3 from 14.0 for the generic group (Table 1). Such a number of places was divided into three groups of approximately 50 students. One of such groups was assigned to a professor who co-authors this work and thus the students of such groups contributed to this study.

The NSPEI course consists of 6 ECTS credits, 60 hours of face-to-face teaching that comprises the following teaching modalities: masterclasses (40 %), classroom practices (52 %) and seminars (8 %). It takes place during the 2nd second half of the school year (February to May). It should be remarked that face-to-face activity was interrupted in the mentioned period by the establishment of the alarm status due to the COVID-19 pandemic.

The activities conducted through ICT and/or in the form of a Flipped Classroom were implemented in different teaching modalities. As an activity of classroom practice, an individual test about scientific competencies was performed through the Socrative tool after the analysis of a text on the issue using the Aronson puzzle technique (Social Psychology Network, 2020) Socrative (https://socrative.com/) is a gamification application that allows the professor to handle students' participation through mobile devices in real-time, to perform tests, evaluations, activities, etc. and provides the professor with detailed data of the marks obtained by the students in the tests conducted (Bello Pintado & Merino Diaz de Cerio, 2017). Unlike the other activities described in this work in which ICT was implemented and did not reflect in the final result of the course, the mark obtained in such a test weighed 13% of the final grade.

In the context of a seminar on the Sun-Earth system, an Excel spreadsheet (https://products.office.com/es-es/excel), developed by Microsoft, was implemented to display the evolution of the daily sun hours graphically in a location selected by each student. Two self-assessment quizzes were also carried out through the Kahoot game-based learning platform (https://kahoot.com/) on the contents that had previously been assessed in masterclasses. Kahoot, as well as Socrative, allows the professor to create multiple choice quizzes and monitor students' responses through mobile devices in real-time. However, unlike Kahoot, Socrative gathers the results obtained by the students in a more detailed report. The Edpuzzle online tool (https://edpuzzle.com/) enables the professor to modify, create and edit interactive videos by entering questions that professors can collect. This tool was used in the context of master lectures to bring in the consumerist perspective. This task corresponded to interdisciplinary work, in which a probable situation in the context of a real school was posed to the NSPEI students. With such aim, a video on consumerism was chosen and questions that students answered individually were inserted in it using the aforementioned online tool.

After the establishment of the health alarm status, the Flipped Classroom methodology was used throughout the four-month period. This methodology consisted of asking students to read the professor's notes, to solve some problems about the contents, to discuss the aroused doubts online, and finally to argue and solve the problems (Milman, 2012).

All the activities mentioned were implemented through the virtual platform eGela (the Moodle platform of the UPV/EHU). The use of this platform as a support for the designed activities was due to its advantages: 1) accessibility from anywhere with an Internet connection, 2) easy updating and use at the time deemed appropriate, 3) no reproduction costs, and 4) interactivity, autonomous learning, acquisition of different cross-cutting skills, etc. (Silva, 2011). It should be emphasized that the accessibility of eGela and other ICT tools, has been critical since the 80 % of face-to-face lessons were unfeasible after the establishment of the health alarm status on 14 March 2020 (the 18th of the 30 scheduled weeks) due to the COVID-19 pandemic.

Chemistry (CH)

As it is shown in Table 1, the CH course is taught in the freshman year of both the Marine Studies and Nautical Studies and Maritime Transport Bachelor`s Degrees at the Faculty of Engineering in Bilbao. As published by the UPV/ EHU, 60 seats were offered at both the aforementioned Bachelor's Degrees in the 2019-2020 academic year and no cut-off grade was established for the generic group in any case (UPV/ EHU, 2019). It should be noted that the offer of this type of Bachelor's Degrees in Spain is low. For instance, according to educaweb (https://www.educaweb.com/nf/carreras-universitarias-de/grado-ingenieria-marina/) such degrees (or similar) are taught at about 19 universities while the search at the same web for Primary Education Bachelor´s Degree results in about 200 sites. Therefore, the home region of the students at Marine Studies and Nautical Studies and Maritime Transport Bachelor`s Degrees at the Faculty of Engineering in Bilbao is probably further away than in other Bachelor's Degrees at the same university, which might add up stress for these freshmen.

Regarding the teaching modalities, the CH course comprehends 6 ECTS credits, hence, 60 face-to-face hours. They consist of master lectures (50 %), classroom practices (17 %), seminars (17 %) and laboratory practices (17 %). The chemistry course takes place during the first half (from September to December). In the case of the mentioned subject, the innovation, ascribed to Flipped Classroom methodology, was implemented in all the laboratory practices. This study is focused on the results obtained in three laboratory groups: two groups that were taught in Spanish (50 enrolled students) and another group that was taught in Basque (6 enrolled students).

According to this methodology, students were asked to go over the theoretical basis and the content of the practices outside the laboratory a week before they took place. Students were also asked to complete and answer a series of questions before the practices. These tasks were mandatory and, although not evaluated or rewarded, their fulfilment was compulsory in order to carry out the laboratory practice.

Motivation on the Use of the Tools

The values of the parameters V, E, I and DR (see equations 1 and 2) presented in Table 2 have been provided by the professor of each course based on the implementation of ICT tools, and M has been calculated according to equation 2. Parameters V, E, I, and DR are considered to range between 1 and 5 integer values (1 being the least and 5 the most), thus total motivation (M) ranges between 0.2 to 125.

As previously indicated, the activity designed with the tool Socrative had an impact on the final mark of the NSPEI course. Therefore, this tool has been assigned with a higher value (V) than the other tools used (Table 2). As for instrumentality (I), it has been considered that the tools Socrative, Kahoot, and Edpuzzle, and Flipped Classroom methodology have a greater projection in the future professional field of NSPEI students than the Flipped Classroom

methodology for CH students. It should be borne in mind that, differently to CH students, NSPEI students will most probably be teachers themselves and will surely use such tools/methodologies or very similar when teaching, thus, such tools are assigned with a 3 and a 1 for NSPEI and CH respectively. On the other hand, the instrumentality associated with Excel utility is considered intermediate for NSEPI students, for in their future as Primary Education teachers they will surely implement such tool but not in their lessons, as they would more probably do with Socrative, Kahhot, Edpuzzle or Flipped Classroom technique. Regarding delay of response (DR), while the results of Flipped Classroom and Excel are long delayed, results for Socrative, Kahoot and Edpuzzle are immediate, so they have been assigned with 1, the minimum possible value.

The rate of return or the ratio between exceeded and enrolled credits on the target courses NSPEI and CH is correspondingly 94 % and around 65 % (on average for the Bachelor's Degree on Marine Studies and Bachelor's Degree on Nautical Studies and Maritime Transport) (UPV/EHU, 2020). Assuming a linear relationship between such ratio and E, it has been concluded that NSPEI students E is 5 and thus it is 3 for CH students (Table 2).

Table 2. Values of the variables in equation 2 for the tools used in NSEPI and CH undergraduate courses

	Socrative	*Kahoot*	Edpuzzle	*Flipped classroom*		*Excel*
	NSEPI	NSEPI	NSEPI	NSEPI	CH	NSEPI
V	2	1	1	1	1	1
E	5	5	5	5	3	5
I	3	3	3	3	1	2
DR	1	1	1	3	3	3
M	30	15	15	5	1	3.3

It can be observed that M ranges between 1 and 30. The minimum value corresponds to CH students regarding Flipped Classroom technique while the maximum corresponds to NSPEI students and the Socrative tool, which, due to the way in which it has been utilized and its projection in the future for NSPEI students, has been assigned with the largest possible values of V, E and I and the minimum value of DR.

FINDINGS

Initial Questionnaire

Before the lessons started, the students were asked about their interests in learning ICT use and their motivation to do so (Figure 1). The students responded on a Likert scale from 1 to 5, where 1 equaled 'nothing' and 5 to 'very much' (Likert, 1932).

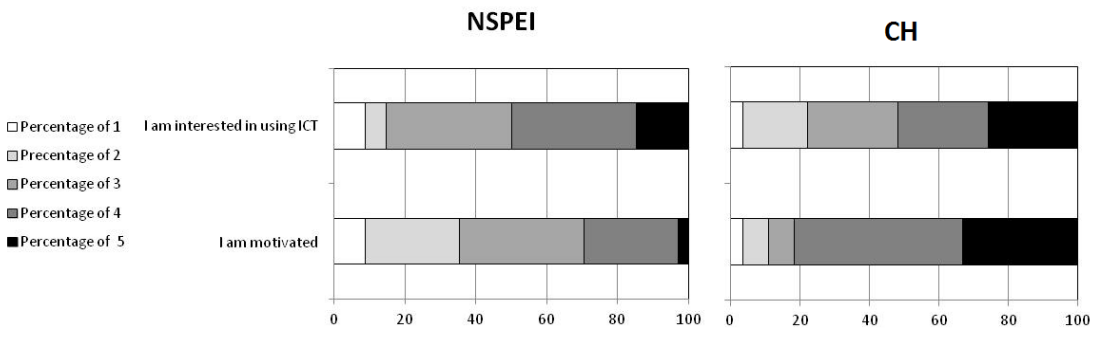

Figure 1. NSPEI and CH students' opinion on interest and motivation in using ICT as addressed in the initial questionnaire

As it is shown in Figure 1, approximately half of both CH and NSPEI students reported that they were interested (4) or very interested (5) in using ICT while clearly more CH than NSPEI students declared they were motivated to learn about it (80 % vs 5 %).

Final Questionnaire

After the implementation of the designed activities, which have been described in the previous section, a questionnaire was carried out in each of the aforementioned courses. Students were surveyed on their satisfaction regarding the teaching methodologies and interactive tools, as well as on their degree of acceptance and usefulness.

The results on satisfaction have been divided into three subsections: (1) general opinion on ICT (Figures 2, 3 and 4); (2) opinion on each specific ICT (Figure 5), and (3) opinion on the innovative role of the tools on the teaching-learning process (Figure 6). The students answered via a Likert scale from 1 to 5, where 1 equaled 'nothing' and 5 to 'very much' (Likert, 1932).

General Opinion on ICT

Concerning the general satisfaction with teaching methodologies, Figure 2 compares the average values obtained in the 10 items included in the final questionnaires for the two courses studied.

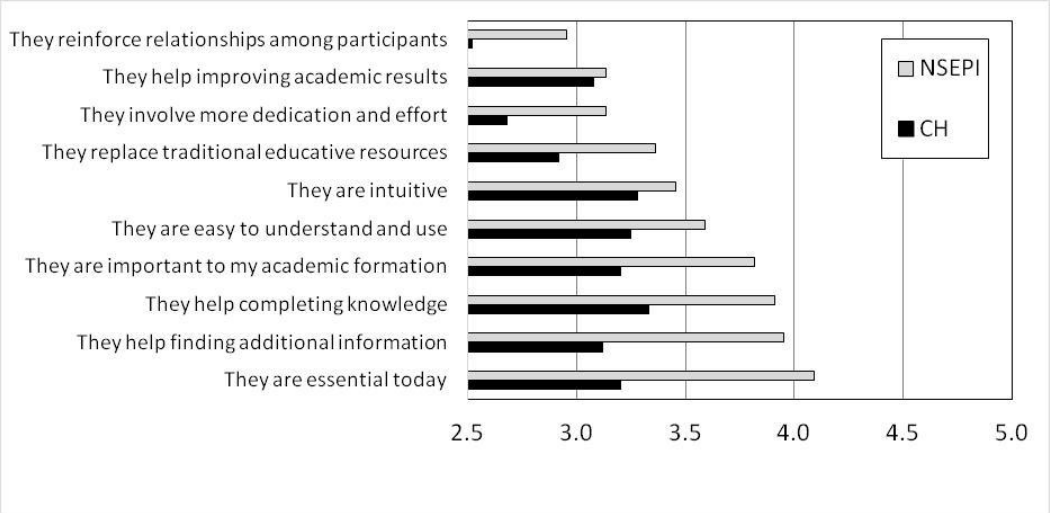

Figure 2. Average values obtained in the final questionnaire on the general opinion of ICT use on NSPEI and CH courses

According to the conclusions derived from Table 2 (the predicted motivation is generally superior for the NSPEI group than for CH), Figure 2 shows that the NSPEI group gave better assessments than the CH group to the utilities of the implemented tools, being in all cases greater than 3.0. Specifically, the score the NSPEI course students gave to the utilities varied between 3.0 and 4.1, while the CH group score ranged between 2.5 and 3.3. CH students allocated less than 3.0 points to the following three items: 'They reinforce relationships among participants'; 'They involve more dedication and effort' and 'They replace traditional educational resources'. These results may be due, among other reasons, to the fact that the CH students might consider Flipped Classroom a too unrewarding effort, which only gives access to the laboratory.

On the other hand, it should be noted that the items that got the most dissimilar marks between CH and the NSPEI students were: 'They are essential today' and 'They help to find additional information', probably because, unlike CH students, the alarm status for the COVID-19 was in force when the NSPEI students responded to the questionnaire. However, both groups agree on attributing an average score of around 3.2 to the item 'They help improve academic results'.

According to the majority of the students surveyed, ICT is essential today in academic training, but according to CH students, who on average attributed less than 3.0 out of 5.0 to it, they do not replace traditional resources, but should be used as a complement to acquire knowledge because they help to seek additional information. CH students also report that ICT tools are easy to understand and use because they are intuitive. The main drawbacks of using ICT pointed out by both groups are that relationships between participants (both students and student-professor) are not fostered, and that students consider that they barely improve their academic results.

For a better understanding of the differences in the results on the two courses, the percentages of the punctuations obtained for each item have been compared for both courses. The percentages of each score (grouping 1 and 2; 3; 4 and 5 values) are shown in Figure 3. This figure also includes the percentage associated with the blank answers (Does not know/Does not answer (DK/DA)).

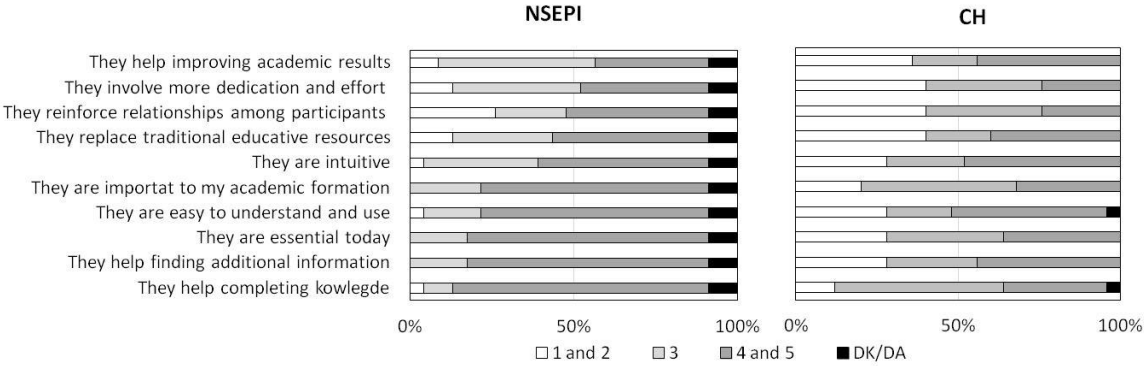

Figure 3. Ranges of valuation percentages obtained in the final questionnaire on the general opinion of ICT use on NSPEI and CH courses

When comparing the distribution of valuation percentages, unlike in CH, higher scores predominate in the NSPEI course (4.0 and 5.0). Namely, the item 'They help complete knowledge' (Figure 3) reaches almost 80 %. The intermediate valuation of 3.0 given in each group varies depending on the item, with no clear trend. In the NSPEI group there is hardly any presence of the lowest valuations (1 and 2), which vary between 0% and 13% %, only attaining the maximum value 26 % at the item "They reinforce relationships among participants". On the contrary, in the CH group such punctuations are quite noticeable. In fact, in some cases the lowest values are given by as much as the 50 % of CH students, i.e. "They help complete knowledge". In the NSPEI group the does not know/does not answer number is constant for all questions.

In general, it can be stated that in the CH group ICT are not as well valued as in the NSPEI group. However, the motivation stated by the CH students in the initial questionnaire was larger than the addressed by the NSEPI students (Figure 1). The good opinion about the use of ICT in of the NSPEI group (Figure 2) could be due to the larger number of interactive activities proposed in the NSPEI course, which were designed to meet the suspension of face-to-face

classes in the UPV/EHU. This fact may have made students aware of the need for this type of tools and, hereafter accustom them to its use considering that, at that particular time, it was the only feasible way of studying and working on the course. Besides, it should be beard in mind that the ICT and methodologies implemented are tools that might be directly implemented in their future professional activity by the NSPEI students, while its applicability might not seem so direct for the CH students.

Comparison of NSPEI Students' Opinion on the Implemented ICT and Vroom´s Model

Concerning the opinion on the implemented ICT, Figure 4 contains the NSPEI students' global valorisation acquired through the final questionnaire. The data shown refer to the obtained average values, within an interval from 0 to 5. Motivation, as calculated from equation 2, is also included in the secondary y-axis, ranging from 0 to 30.

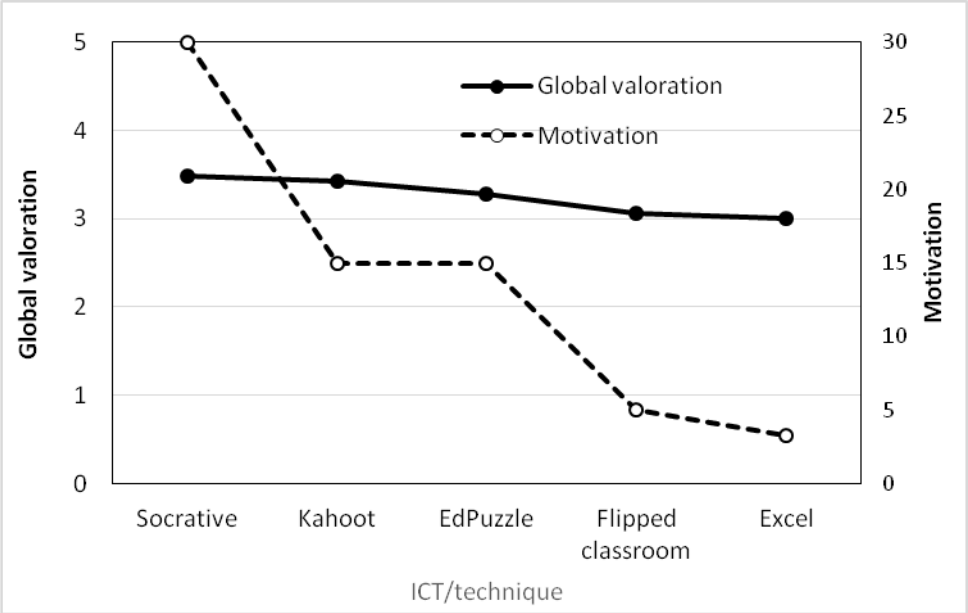

Figure 4. Average values obtained in the final questionnaire on the overall valuation and calculated motivation (Table 2) of the different ICT used in NSPEI

As it can be observed in Figure 4, all implemented ICT tools are valued globally with at least 3.0 points out of 5.0, being Socrative and Excel the most and least valued, respectively (Figure 4). Such might be since the Excel spreadsheet does not provide any gamification, while it is a basic feature of Socrative. The sorting in tool valuations generally meets the order in the motivation values predicted by the Vroom model (Table 2), only Edpuzzle differs from this trend. Namely, this interactive tool is valued worse than Kahoot probably because it is more unknown than Kahoot and therefore the students attribute less utility (I) to it when compared with the value predicted in Table 2. To know the reason for these differences between the overall ICT tools assessments in the NSPEI course, all responses were analyzed taking into account five aspects: motivating capacity, collaborative attitude, understanding, self-assessment and autonomy. The results obtained from this data analysis are shown in Figure 5, which also agrees with the statements in Figure 3. As the results collected in Figure 4 suggest, NSPEI students value the tool Socrative the most in most aspects, except for motivation, in which the tool Kahoot gets the best grade. Of all the items explored, 'Learning Autonomy' for Socrative's activity scored best (4.0 out of 5.0). This may be because, as the NSPEI students reported in their initial questionnaire, Kahoot was the least unknown tool and thus it can raise more interest and motivation for the student.

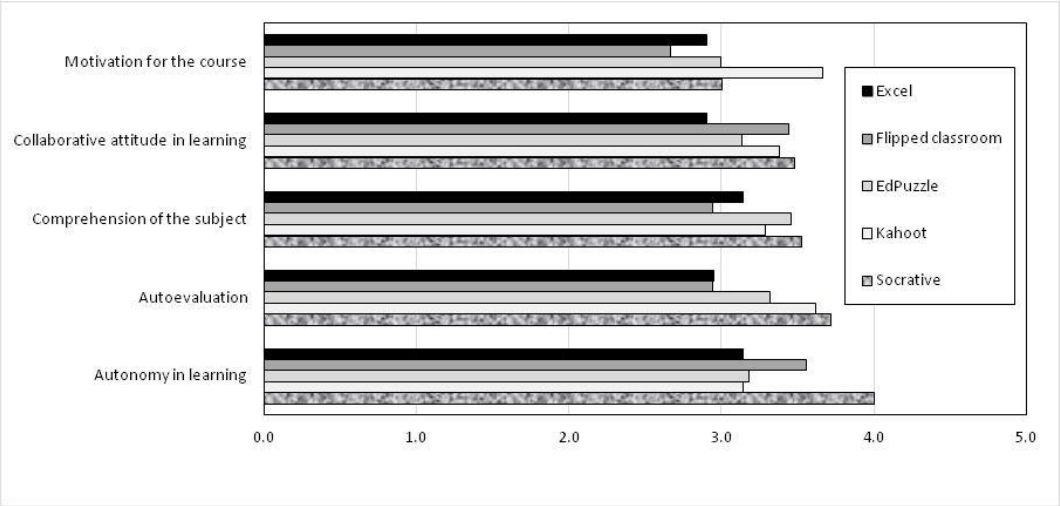

Figure 5. Average values obtained in the final questionnaire on ICTs used in Natural Sciences in Primary Education I (NSEPI)

The ICT that in the overall valuation obtained the best score (Socrative, Kahoot and EdPuzzle) (see Figure 3), have a rating greater than 3.0 at all items (Figure 5). The worst-rated tools in the graph above (Flipped Classroom and Excel) get a lower rating than 3.0 in 3 of the 5 items, agreeing to fail below 3.0 in two of them: 'Motivation for the course' and 'Auto-evaluation'. Seemingly, the perception of these two items is related, since if these tools are not motivating, it should be expected that students will not use them for self-assessment. These low values may also be linked to the fact that Flipped Classroom involves greater personal effort and attention from students, and that Excel is a resource that has a presumably less future projection in the professional practice of Bachelor's Degree in Primary Education students, as mentioned when setting the utility (I) value (Table 2).

Opinion of the Innovative Role of the Tools on the Teaching-Learning Process

Based on their experience, the teaching team classified the ICT tools, formats and methodologies implemented in the courses according to their degree of innovation and allowed each of them a score in the range of 1 to 5, as shown in Figure 6.

Also, NSPEI students have posed the following questions on the implemented ICT tools and methodologies: 'When learning, understanding, setting concepts and knowledge, etc., what has been easier for you?' The score ranged between 1 and 5, and the response for each ICT and/or methodology is shown in Figure 6 together with the values suggested in Table 2.

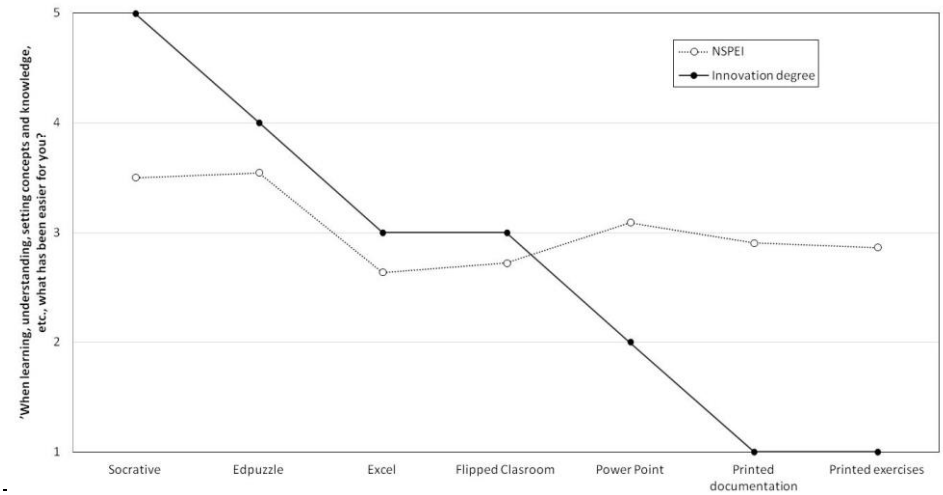

Figure 6. Average values obtained in the survey on ICTs used in NSPEI and the innovation degree of the ICT/Methodology

No relationship between the innovative degree of the ICT tools, the formats and methodologies implemented and its capacity to help NSPEI students to learn, understand and set concepts and knowledge, etc., can be observed in Figure 6.

CONCLUSION, DISCUSSION AND SUGGESTIONS

Different interactive teaching tools supported by Information and Communication Technologies (ICT) have been employed for designing various activities which were implemented in different courses. This implementation aimed to analyze their suitability to increase motivation in freshmen students. To this end, the students of two first-year courses: Nature Sciences in Primary Education I (NSPEI, Bachelor's Degree in Primary Education) and Chemistry (CH, Bachelor's Degree in Marine Studies and Bachelor's Degree in Nautical Studies and Maritime Transport), have been surveyed in relation to their opinions on the above-mentioned tools.

Regarding ICTs in general, students in both courses believe that they are essential, but that they do not replace traditional educational resources. Particularly such is the opinion of the CH students who, unlike NSPEI students, were not confined due to the state of alarm derived from the COVID-19 pandemic. The negative aspects students highlight are the lack of interpersonal relationships that their use entails and the fact that they (by themselves) do not help improve academic results. In short, students consider that digital tools and novel methodologies complement traditional educational resources. Such findings cohere with those reported by Thi Thai et al. (2017), according to which students in a blended learning setting had a higher learning performance as compared to those in an e-learning setting.

Regarding the tools raised in the course NSEPI, students value Socrative, Kahoot and EdPuzzle tools better than Flipped Classroom or Excel, which agrees with the motivation capacity of such tools as calculated through the Vroom model. And yet, as reported by Díaz-Garrido et al. (2017), the capacity of Flipped Classroom for motivating students might be higher than that of traditional resources. In the case of the Flipped Classroom, a methodology used in the two courses, NSEPI students have a better perception of it, seemingly because such students may be more motivated in the use of such methodology, as well as ICT, for they will most likely implement them in their future professional activity. Also, as previously mentioned, NSPEI students were confined to their homes when the course took place, which might have made up their minds about the convenience of ICT. Such classification matches the suggested by Mc

Nelly et al. (2016), who found that Flipped Classroom endorsers had more positive attitudes towards the course activities (both pre-class and in-class) and felt more involved and engaged in the content. In this sense, we agree with Tomás et al. (2019) who suggest a flipped learning continuum that fosters different levels of student-centered learning and autonomy. And, particularly in the context of the first year experience, they recommend some teacher-led instruction to support students' transition to learning in higher education. In future studies, research on the impact on higher degree courses students' motivation of scientific-technological grades of Flipped Classroom in combination with ICT will be carried out.

On the other hand, Flipped Classroom may rely on ICT which, in combination with the former or just by themselves, have proved to be essential in times or situations when presential lessons are not feasible. Moreover, according to the results obtained in this work, it can be concluded that if the ICT formats are properly selected, they can be powerful motivating tools. However, and despite the fact that the students in this study agreed with the need for ICT, they also pointed out that they would not replace traditional educational resources. Hence, the choice of blended learning may be the most appropriate teaching-learning method.

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