

## **SAME HUMAN RESOURCES AND MATERIALS, SAME ICT: SAME RESULTS?**

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### **Abstract**

The implementation of the degrees in Spanish universities was accompanied by the incorporation in the classrooms of new methodologies and pedagogical tools that sought to answer new questions raised related mainly to a lower presence of students in the classrooms and an increase in their autonomous work.

Several studies have been devoted to the analysis of their use. In the case of one of these tools, the clickers, an electronic voting system that allows real-time monitoring of what happens in the classroom, the results have been very good. Indeed, in almost all the cases in which its use has been incorporated the performance of the students has experienced a remarkable increase and, in addition, their perception regarding its use shows is more than satisfactory.

However, it should be noted that the heterogeneity among the students may influence these conclusions, that is, even if most of the factors involved (such as faculty members, content taught, methodologies and ICTs) were constant it would not be possible, in principle, to predict the results, since the students' profile is a non-controllable, significant factor.

Thus the objective is to verify the existence of significant differences in the perception, by students, about the use of clickers, having fixed the previously mentioned factors. For this purpose a causal sample of students from a grade offered by the Universitat de València will be used.

The results show differences in their perception about their use, depending on each student's academic profile, with discrepancies around 30% for some of the qualitative characteristics.

It is concluded, therefore, that it would be advisable to accompany the use of ICTs with a previous assessment of the profiles of the students to whom it will be directed.

**Keywords:** clickers, profiles, factors, ICT, academic performance.

## 1 INTRODUCTION

The gradual and almost massive incorporation of Information and Communication Technologies (ICTs), in the development of classes in Spanish universities, has been accompanied by multiple researches that have allowed us to analyze their strengths and weaknesses in the teaching-learning process (Agudo et al., 2014; Calvo and Mingorance, 2013). In almost all of them it concludes the positive effect of its use.

These ICTs include clickers, an electronic voting system (EVS) (Caballer-Tarazona and Pardo-García, 2014; Martyn, 2007) that enables immediate feedback on the concepts worked in the classroom. Its use has provided good results in the performance and involvement of students in both undergraduate and graduate studies (López and Barac, 2016, López et al., López et al. 2017 (a).

The research cited is part of a long list of those that aim to analyze the benefits of using ICTs. However, there is little research that aims to analyze the perception that students have of the repercussion of the use of this ICT in their own learning process. And even lower are those that follow the goal to see if the results of the application of this technology is independent of the audience, that is, if it produces the same results regardless of the profile of the students (their gender, their turn of attendance to class, pre-university studies, etc.).

This will be the goal of the present study, to analyze if the profile of the students influences the perception that this has of the ICTs. For this purpose, the information collected through an ad-hoc questionnaire to students of a degree offered by the University of Valencia will be used.

As indicated in (López et al., 2017 b), the questionnaire consisted of the following 10 questions: 1st) Did the use of clickers help us to better understand the concepts of the subject? (Helps in concepts understanding), 2nd) Did the use of clickers contribute to make better use of the class? (Increases performance in the classroom), 3rd) Does the use of clickers make the class more enjoyable? (Makes lessons friendlier), 4th) Does using clickers make the class more participatory? (Increases motivation to take part in class), 5th) Did the use of clickers help you prepare the exams better? Clickers are good practice before exams), 6) Has the use of clickers contributed to improving your continuous assessment grade in the subject? Improves continuous evaluation grades), 7th) Evaluate, on a scale of 0 to 10, your experience with the use of Clickers, 8th) Gender, 9th) Class attendance group and 10th) Write below any comments that you consider opportune about the use of Clickers.

With the information obtained through the survey it was concluded that the use of clickers was very well received by the students, since about 80% said that the use of the clickers had contributed to a better understanding of the concepts and to make the different sessions more enjoyable and participative, in addition to having an increase in the continuous evaluation score (opinion that was supported by approximately 40% of the respondents). On the other hand, when the tool was used an average score of 7,24 was obtained (on a scale of 0 to 10), the average being representative since Pearson's coefficient of variation was 0.26.

Taking up, therefore, the question raised above, it is questionable whether the use of this ICT would give rise to the same results and would be welcomed by the students to whom it was addressed, ie if the results mentioned are relatable to any situation or, as it is to be expected, they would differ according to the human factor, that is to the audience to whom it was directed.

Taking advantage of the exceptional situation that the data that compose the causal sample (Azorín and Sánchez-Crespo, 1986) with which we work correspond to two groups of different registration and shift (one morning, the G1, and another in the afternoon, the G2), the objective of the present work is to analyze if there are significant differences in the perception and valuation of the students attending to the enrollment group. That is, if we keep some of the fundamental factors of the teaching-learning process constant, the "student profile" factor makes a significant difference in the results of the questions raised.

If the existence of such differences were detected, it would be advisable to carry out, in any academic situation, a previous study of the students in order to adjust to their profiles the most appropriate and profitable ICTs.

To achieve the proposed objective, a descriptive study will be carried out, which will be complemented by an inferential one in those cases in which the characteristic considered so permits. Specifically:

- To analyze the existence of significant differences in the case of the first 6 questions raised (likert scale at 5 levels) will make a comparative descriptive level through the use of tables of relative frequencies and pie chart.

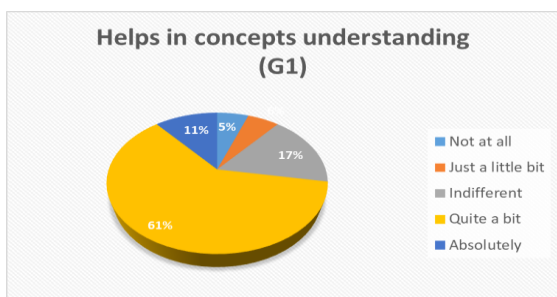
- For the only quantitative characteristic ("assessment in the use of Clickers"), the comparative at the descriptive level will be carried out using frequency tables and bar charts, as well as some of the most representative reduction measures (average, median, mode, minimum, maximum, typical deviation and coefficient of variation). This analysis will be completed with an inferential one, using ANOVA of a factor at two levels, which will allow to conclude whether the differences detected at the descriptive level are significant.

## 2 COMPARATIVE ANALYSIS OF THE DATA ACCORDING TO THE PROFILE "GROUP OF MATRÍCULA"

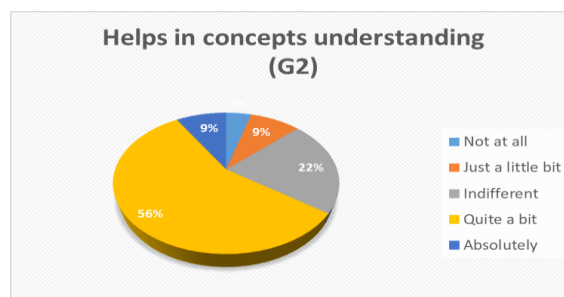
According to the objective and methodology presented in the previous section, in the first 6 questions (likert scale with 5 levels) in table 1 the percentages corresponding to each level of this scale are collected by question and group (G1 or G2), and in the sector graphs (Figures 1 to 6) the graphical representation of these percentages.

Table 1. Percentage share scale likert according to group

	QUESTIONS											
	Helps in concepts understanding		Increases performance in the classroom		Makes lessons friendlier		Increases motivation to take part in class		Clickers are good practice before exams		Improves continuous evaluation grades	
	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2
Not at all	5,56%	4,35%	0,00%	8,70%	0,00%	0,00%	0,00%	0,00%	5,56%	13,04%	0,00%	8,70%
Just a little bit	5,56%	8,70%	5,56%	8,70%	0,00%	0,00%	0,00%	8,70%	5,56%	17,39%	27,78%	13,04%
Indifferent	16,67%	21,74%	16,67%	17,39%	0,00%	13,04%	11,11%	4,35%	33,33%	26,09%	50,00%	26,09%
Quite a bit	61,11%	56,52%	44,44%	56,52%	38,89%	39,13%	27,78%	34,78%	44,44%	34,78%	16,67%	43,48%
Absolutely	11,11%	8,70%	33,33%	8,70%	61,11%	47,83%	61,11%	52,17%	11,11%	8,70%	5,56%	8,70%

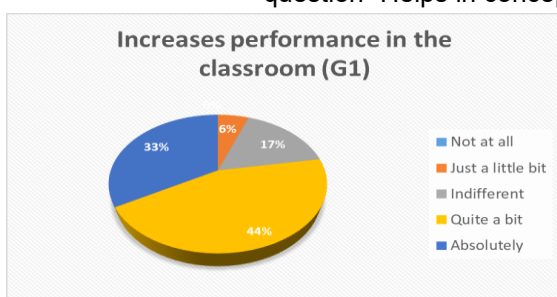


a)

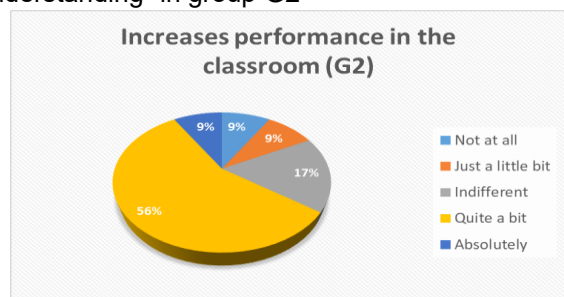


b)

Fig. 1 a) Responses to the question "Helps in concepts understanding" in group G1, b) Responses to the question "Helps in concepts understanding" in group G2



a)



b)

Fig. 2 a) Responses to the question "Increases performance in the classroom" in group G1, b) Responses to the question "Increases performance in the classroom" in group G2



Fig. 3 a) Responses to the question “Makes lessons friendlier” in group G1, b) Responses to the question “Makes lessons friendlier” in group G2

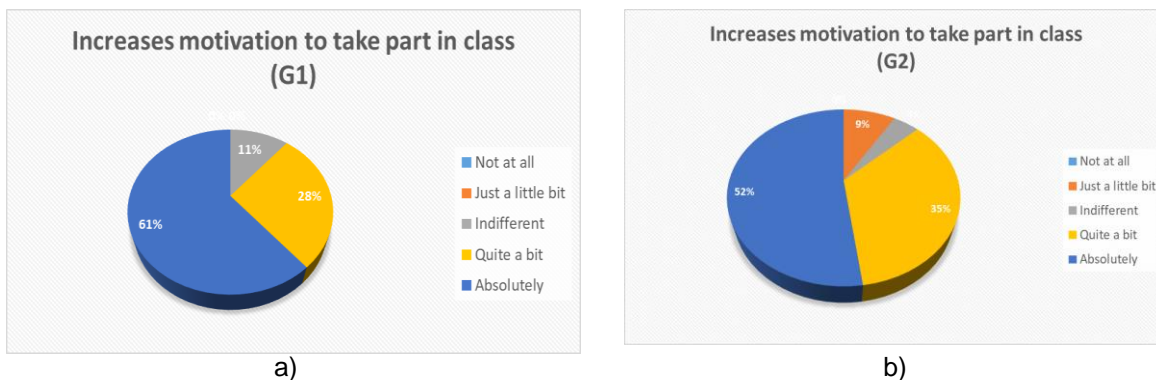


Fig. 4 a) Responses to the question “Increases motivation to take part in class” in group G1, b) Responses to the question “Increases motivation to take part in class” in group G2

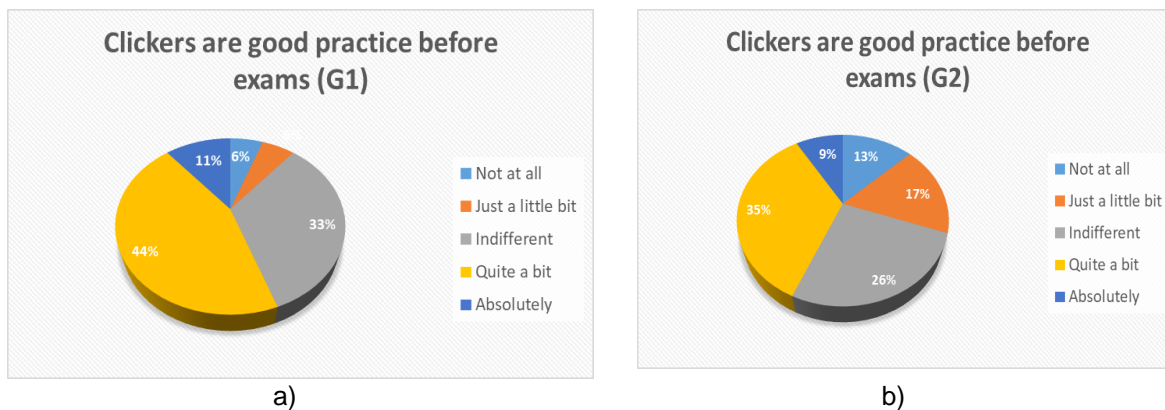


Fig. 5 a) Responses to the question “Clickers are good practice before exams” in group G1, b) Responses to the question “Clickers are good practice before exams” in group G2

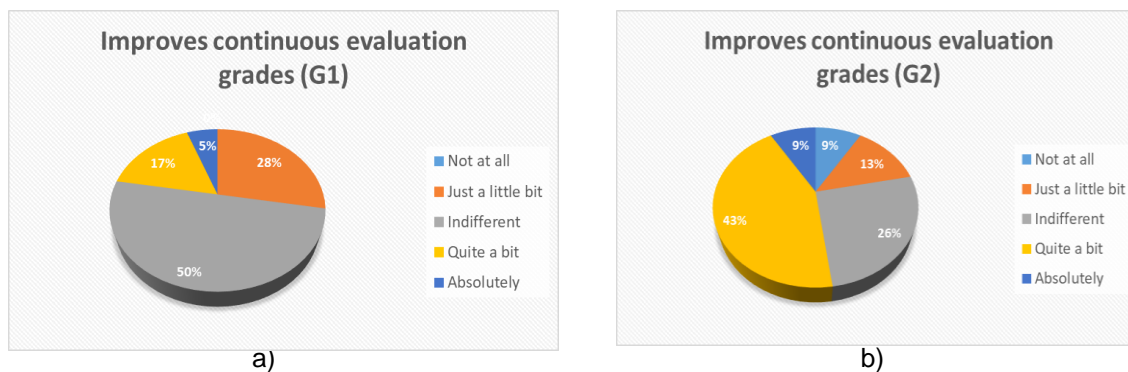


Fig. 6 a) Responses to the question “Improves continuous evaluation grades” in group G1, b) Responses to the question “Improves continuous evaluation grades” in group G2

From his observation it follows that:

- If we consider the questions related to students' perception of the use of clickers in the classroom: "Helps in concepts understanding", "Increases performance in the classroom", "Makes lessons friendlier" and "Increases motivation to take part in class, the percentage of respondents who show good consideration ("Absolute" or "Bit by bit") differs between the two groups, being 72.22%, 77.78%, 100% and 88.89 respectively % for G1 and 65.22%, 65.22%, 86.96% and 86.96% for G2. That is, they are lower in G2 for the 4 cases considered.

- The conclusion is not the same for the questions that refer to the repercussion that the use of the clickers has for the student in the preparation of the tests of the continuous and final evaluation of the subject ("Clickers are good practice before exams" and "Improves continuous evaluation"), being respectively 55.56% and 22.22% for G1 and 43.48% and 52.17% for G2. That is, for the first of the questions the best results of G1 are maintained against G2 but in the second question this fact is reversed, presenting better G2 results.

Thus, students in group G1 have a more favorable perception of clickers than those in G2 in 5 of the 6 Likert scale issues raised.

Regarding the question regarding the assessment that the student provides to the use of clickers (scale from 0 to 10), table 2 corresponds to the table of frequencies of Grade, attending the group, and the bar diagram of the "Assessment in the use of clickers "(Figure 7) allows a comparison of Grade between G1 and G2.

Table 2. Frequency table of assessment (AS) by group

Grade	ni		Fi		Ni		Fi	
	G1	G2	G1	G2	G1	G2	G1	G2
0	0	0	0,00%	0,00%	0	0	0	0
1	0	0	0,00%	0,00%	0	0	0,00%	0,00%
2	0	0	0,00%	0,00%	0	0	0,00%	0,00%
3	1	3	5,56%	13,04%	1	3	5,56%	13,04%
4	0	0	0,00%	0,00%	1	3	5,56%	13,04%
5	0	3	0,00%	13,04%	1	6	5,56%	26,09%
6	1	2	5,56%	8,70%	2	8	11,11%	34,78%
7	6	3	33,33%	13,04%	8	11	44,44%	47,83%
8	3	8	16,67%	34,78%	11	19	61,11%	82,61%
9	5	4	27,78%	17,39%	16	23	88,89%	100,00%
10	2	0	11,11%	0,00%	18	23	100,00%	100,00%

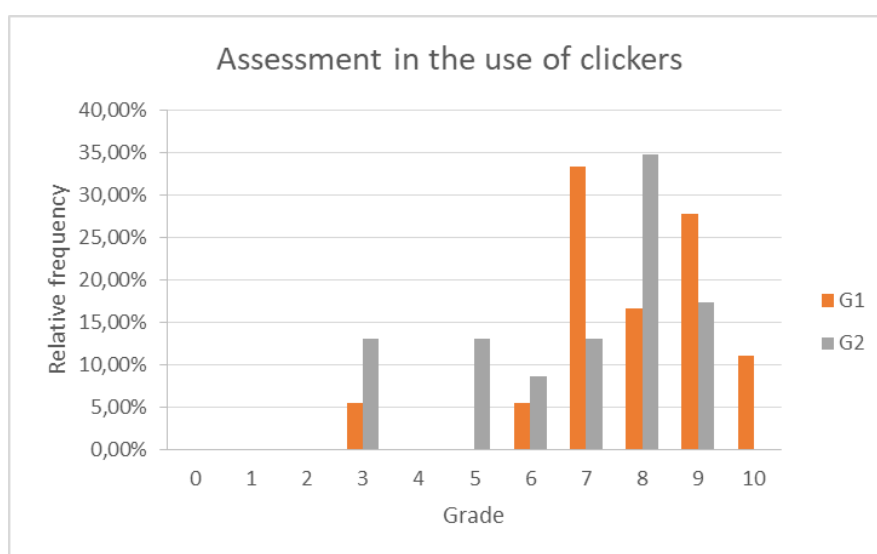


Fig. 7 Grade's bar chart according to group

From the observation of both it is concluded that:

- The percentage of students who give a rating of 9 or more to the use of clickers is 38.89% in G1 and 17.39% in G2.
- The percentage of students that give a rating of 8 or more to the use of clickers is 55.56% in G1 and 52.17% in G2.
- The percentage of students that give a rating of 7 or more to the use of clickers is 88.89% in G1 and 65.22% in G2.

That is, they present better results, regarding the valuation, the respondents of G1.

On the other hand table 3 shows the most relevant parameters as a function, again, of the group of surveyed students.

Table 3. Parameters of assessment (AS) by group

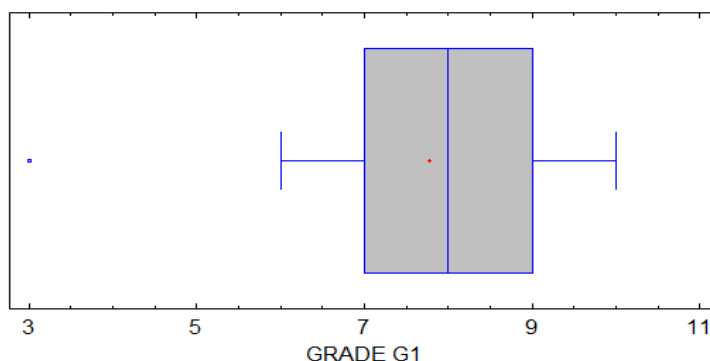
PARAMETERS	AS	
	G1	G2
Average	7,78	6,83
Typical deviation	1,67	1,97
Coefficient of variation	0,21	0,29
Median	8	8
Mode	7	8
Minimum	3	3
Maximum	10	9
Standardized bias	-2,15	-1,7
Standardized kurtosis	2,48	-0,3

If the parameters are compared, considering the enrollment group, it follows that:

- The mean score for G1 (7.78) is higher than for G2 (6.83). That is, on average, clickers are best valued by the students surveyed in G1.
- The coefficient of variation of Pearson is lower in G1 (0.21), so the average value of G1 besides being higher than that of G2 is also more representative.

In order to analyze whether the difference between the mean values is significant, we proceed to the analysis of the variance (ANOVA) of a factor at two levels (Romero and Zúnica, 2008). For this, it is necessary to verify compliance with the Normality hypothesis.

In this sense, according to the values of the standardized bias and the standardized kurtosis (out of range -2, 2), the normality hypothesis is rejected for G1 valuations. This rejection could be due to the existence of some anomalous data. In order to detect its existence or to discard it, we represent the Box-Plot of Grade G1 diagram (Figure 8).



That allows visualizing the existence of an anomalous data, corresponding to the value 3. Once removed, we proceeded again to obtain the values corresponding to the measures of position, contained in table 4

Table 4. Parameters of assessment (AS) according to group (debugged)

PARAMETERS	AS	
	G1D	G2
Average	8,06	6,83
Typical deviation	1,20	1,97
Coefficient of variation	0,15	0,29
Median	8	8
Mode	7	8
Minimum	6	3
Maximum	10	9
Standardized bias	0,21	-1,7
Standardized kurtosis	-0,92	-0,3

In this case, the values of the standardized bias and the standardized kurtosis (within the range -2, 2) making it possible to assume the Normality hypothesis for both populations (valuations provided by G1 and G2 students) so we can carry out the previously cited ANOVA.

Thus table 5 corresponds to the ANOVA table, which shows the decomposition of the total variability as a sum of the between groups and intra groups.

Table 5. Table of ANOVA

Source	Sum of Squares	Df	Mean Squares	F-ratio	P-value
Between groups	14,8545	1	14,8545	5,21	0,0281
Intra groups	108,246	38	2,84857		
Total	123,1991	39			

And taking into account the P-value (0.0281) it follows that for a significance level greater than or equal to 3% the equality of means is rejected, that is to say there is a significant difference as far as the valuation of the use of the clickers of the two groups (G1 and G2), so that from the average values contained in table 4 on average students in group G1 give a higher score to the use of clickers than students in group G2.

### 3 CONCLUSIONS

As stated, the objective was to verify if after keeping constant the factors (the same teaching team, same methodology, same subject content, ...), the factor "student profile" influenced the student's perception of the use of ICTs in their own learning process.

For this purpose, it has been considered a subject in which one of these ICTs, the clickers, has been used. It is a subject that is part of the curriculum of a degree offered by the University of Valencia, and can be studied in two groups of different shifts (morning and afternoon). This was the profile whose influence was analyzed: the enrollment group.

The analysis of the information provided by a random sample of students through their answers to an ad-hoc questionnaire has allowed us to conclude that:

- In the information corresponding to Likert scale questions (at level 5), a difference of between 2 and 30 points is observed in the percentage of students who select the last two levels ("Quite a bit" or "Absolutely"). Concretely in all the questions corresponding to the block about the students' perception of the use of clickers inside and outside the classroom, the percentages are lower in G2, and only when referring to "Improves continuous evaluation grades" the difference, of about 30 points, is in favor of the G2 group. It could, therefore, be concluded that the students of group G1 value more positively the use of

the clickers.

- With respect to the students' evaluation of the use of clickers (scale from 0 to 10), a first descriptive study reflects that the students of the first group are more satisfied with the use of this pedagogical tool, providing an average score of 7.78 compared to 6.83 for the second group, with an inferior coefficient of variation for G1, which makes the mean more representative than in G2.

A subsequent inferential study, using ANOVA, allows us to assume the significance of this difference, considering levels of significance greater than or equal to 3%.

That is, given that there has been a better reception of clickers by G1 students, we could confirm a suspicion that "student profile" may influence the perception of the student in the use of pedagogical tools.

This point is important when selecting the best ICTs in the development of the classes, because depending on the results obtained in the work presented it would be more than recommendable to determine the profile of the students to whom they are addressed.

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