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Effects of the PowerPoint methodology on content learning

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Abstract

Purpose: This study focuses on whether the use of PowerPoint technology as the main resource to convey information has an effect on students' learning compared with classes taught without this technology.

Design/methodology/approach: The sample consisted of 205 psychology students, divided into four groups, who were taught an ordinary Educational Psychology lesson. In two of these groups, a PowerPoint presentation (19 slides) was used to deliver the contents, while in the other two the same contents were delivered by the professors with the only aid of the blackboard. After the lesson, students' learning was assessed by means of a questionnaire consisting of ten multiple-choice items.

Findings: Results showed significant differences ($p < 0.000$), with the scores of the groups without PowerPoint an average of 19% higher than the groups with PowerPoint.

Originality/value: The use of technology can have a very positive influence on learning, provided that its use fits the circumstances inherent in learning.

Keywords: learning, PowerPoint, evaluation, content

JEL code: I210

Title: *Efects of the PowerPoint methodology on content learning*

Resumen

Objeto: Este estudio se centra en los efectos del PowerPoint como medio principal de transmisión de contenidos en el aprendizaje del alumnado, comparándolos con el aprendizaje obtenido a partir de clases en las que no se usa esta tecnología.

Diseño/metodología/enfoque: Se utilizó una muestra de 205 estudiantes de Psicología, repartidos en cuatro grupos, tomando como situación de aprendizaje una de las clases ordinarias de la materia de Psicología de la Educación. En dos de estos grupos se utilizó una presentación de 19 diapositivas PowerPoint para presentar los contenidos, mientras que en los otros dos grupos estos mismos contenidos fueron presentados por los profesores, con la única ayuda de la pizarra. Después de la clase, los asistentes fueron evaluados mediante un cuestionario de diez preguntas de elección múltiple.

Resultados: Los resultados mostraron diferencias significativa ($p < .000$), siendo las puntuaciones medias de los grupos sin PowerPoint un 19% superiores a las de los grupos que recibieron la clase con esta tecnología.

Originalidad/valor añadido: El uso de la tecnología puede tener una influencia muy positiva en el aprendizaje; siempre que su uso se ajuste a las circunstancias inherentes del mismo.

Palabras Clave: Aprendizaje, PowerPoint, evaluación, contenidos

Código JEL: I210

Introduction

The information and communication technologies (ICTs) have become rather deeply rooted in educational settings. Their use has fostered qualitative changes in how teaching is approached, especially in terms of presenting contents audiovisually, where PowerPoint is the most often used tool.

PowerPoint is a software programme that has become a basic means of delivering presentations in both lecture halls and educational centres. Every day more than 30 million presentations are delivered with PowerPoint (Savoy, Proctor & Salvendy, 2009). More than 20 years have elapsed since PowerPoint first appeared, and since then its presence in classrooms has risen considerably. Specifically, 90% of Psychology professors at the university where the authors work use PowerPoint in their theoretical classes, and of them, almost 50% literally

transcribe the content that is projected onscreen. This massive presence of PowerPoint in today's educational culture has prompted a debate on its use and effectiveness. This study aims to provide new information on the use or abuse of PowerPoint. Specifically, the main goal of this study is to compare the effectiveness of the learning among students in a class taught by a professor who faithfully follows the contents of a PowerPoint presentation compared to the same class taught with no kind of computer support, that is, only with the verbal transmission of the contents by the professor.

There are still few empirical studies that evaluate the effectiveness of PowerPoint technology. The largest number of references comes from prescriptive publications in which they aim to share strategies and procedures for effectively using the programme and, in doing so, highlight the advantages and disadvantages of using it (Babb & Ross, 2009; Jones, 2006; Lowry, 2003; Szabo & Hastings, 2000; Vernadakis, Antoniou, Giannousi, Zeton & Kioumourtzoglou, 2011). A second group of publications includes opinion articles, which began to appear in American magazines with large circulations in 2000. Within this second group, Tufte (2003) is prominent, and his criticisms can be summarised in the following five points: 1) the excessively schematic nature of PowerPoint simplifies or hinders the complexity of certain ideas from being conveyed; 2) the indiscriminate use of colour, animation and sound impede direct comprehension of the contents; 3) PowerPoint is an aid to the speaker but not to the audience; 4) due to its low resolution, it is an inefficient tool for displaying tables and graphs; and 5) its set-up imposes a rigid, linear reading order based on bullet points.

Subsequently a series of theoretical studies appeared which, unlike authors like Tufte, believed that the tool was not negative in itself but that it had inefficient users. PowerPoint, just like any other system of coding meanings, has features that affect the production and reception of both the end result and the structure of the contents (Farkas, 2006; Stoner, 2007). In this sense, Neville (2004) identified three uses of PowerPoint: a) as a guide for the speaker; b) as a guide for the listener/reader; and c) as a text to solely be read independent of oral discourse. In the mind of this author, the only purpose that PowerPoint can accomplish effectively is the second.

The detractors of this instrument also argue that the use of PowerPoint inhibits presenter-audience interaction (Driesnack, 2005), limits the number of details that can be presented (Tufte, 2003) and lowers the communicative quality of the presentations (Stein, 2006). On the other hand, the supporters claim that using PowerPoint improves learning (Lowry, 1999), raises audience interest (Szabo & Hastings, 2000) and helps in explanations of complex illustrations (Apperson, Laws & Scepansky, 2006). The positions of the different authors cited, regardless of whether they are in favour or against PowerPoint, are grounded upon general knowledge of the communication process and largely on the kind of particular experience each author has had. For this reason, with all due respect to the arguments wielded, they can

essentially be regarded as statements of opinions more than as systematic facts or results, thus making their scientific value relative.

In the past decade, there has been a notable rise in interest in comparing the effectiveness of distance versus traditional education, the latter referring to teacher-centred classes (Ali & Elfessi, 2004; Brown & Liedholm, 2002; McLaren, 2004; Rusell, 1999; Schulman & Sims, 1999; Vernadakis et al., 2011). With the idea of resolving this question, different studies (Dziuban, Hartman & Moskal, 2004) have analysed the results of blended learning, which consists of combining the best of distance education with the best of traditional education. The blended learning model essential entails face-to-face interaction between the student and teacher coupled with online computer-mediated communication (Mitchell & Honore, 2007).

Despite the fact that blended learning is beginning to be viewed as a feasible solution to the plethora of limitations in traditional classes, some studies show that online students prefer face-to-face contact with their teacher and perform better with this model than with blended learning (Riffell & Sibley, 2005). In this context of face-to-face interaction between teacher and student, two variations in the traditional teacher-centred class have to be distinguished: first, classes in which the teacher's oral discourse is the main tool in conveying a sequence of contents, along with the time spent on them and the illustrative elements. Secondly is the increasingly widespread method among educators revolving around the computer tool, PowerPoint, in which a sequence of contents is defined in the presentation and the educator acts as a commentator (sometimes, merely a reader) of the verbal materials projected.

Drawing from psycho-educational theory, Mayer and Moreno (2003) suggest the necessary convergence of three elements in order to achieve an "intelligent use" of technological resources in education: cognition, instruction and technology. Within cognitive theory, the effectiveness of multimedia learning results from these three questions (Veronikas & Shaughnessy, 2005): (1) How do people learn?; (2) How can the learning experience be facilitated?; and (3) How can technology be used to improve the learning process? This last point serves as the framework for the main goal of this study: to evaluate the effectiveness of PowerPoint in the process of learning contents.

Even though they are few and far between, some empirical studies have been conducted which set out to determine the impact that PowerPoint has on the teaching/learning process, referring to teachers' and students' perceptions of the programme (Mackiewicz, Mastarone & Lee-Kim, 2006) or the differing perspectives between experts and university students (Mackiewicz, 2008). A second focal point of interest has been the attempt to determine experimentally whether receiving classes taught by PowerPoint positively affects students' academic performance (Moreno & Mayer, 2002; Blokzijl & Andeweg, 2005; Amare, 2006; Susskind, 2008). Some of these latter studies are methodologically diverse (in the amount and

kind of information contained on the slides, in the knowledge the students had on what they were being evaluated on, in the age of the subjects evaluated, etc.), so it is difficult to compare them, and furthermore, they reach contradictory conclusions. Thus, while Moreno and Mayer (2002) and Blokzijl and Andeweg (2005) point to the effectiveness of PowerPoint in the recall of the material presented in class, other studies have shown how students achieve better results in a teacher-centred class without a PowerPoint presentation (Amare, 2006; Erwin & Rieppi, 1999), or simply no significant differences are observed between the two groups studied (Apperson et al., 2006; Barlett & Strough, 2003; Susskind, 2008). Other studies (Savoy et al., 2009) have focused on the effectiveness of the recall of material depending on the kind of information presented (graphic or verbal), stressing that students recalled around 15% less verbal information when it was presented with PowerPoint.

Beyond shedding light on this controversy, to the extent possible, in this study we set out to determine whether using the PowerPoint methodology to present verbal contents in a teacher-led class affects student learning. Unlike the studies performed up to date, in this study we consider the presence of the PowerPoint methodology or resource not as an element to complement the educational discourse but as the main element in the presentation of the contents, while the educator's discourse is what serves as a complement. Specifically, we shall observe whether there are differences between the evaluations of the same contents taught with or without the presence of PowerPoint as a methodological resource which is used as the main tool in the class session.

According to educational psychology theory, more and better learning is expected to take place in a context in which the teacher is the main emitting information source and interacts with the listeners, managing the communicative elements (language, gesture, para-verbal elements), the distribution of time and the stress or emphasis on the different points according to the indicators of students' comprehension, compared to the situation in which the teacher essentially spends his or her time reading the contents presented on PowerPoint slides. Thus, while in the former case the teacher directs the listeners' attention to the points he or she considers the most relevant, in the latter they have to divide their attention between the material being projected onscreen and the teachers' comments, although studies show that students normally focus on the literal copy of the text on the slides (Cladellas & Castelló, 2010; Grabe, 2005; Driessnack, 2005). On the other hand, the teacher's attention shifts from capturing indications of comprehension, and adjusting his or her speech accordingly, to focusing on the contents presented on the slides. Despite this, as some studies suggest (Apperson et al., 2006; Savoy et al., 2009; Susskind, 2005; Szabo & Hastings, 2000), the presence of PowerPoint in classrooms is a motivating factor for students, most likely because it helps them in their note-taking.

According to what we have discussed until now, we have posited the following hypothesis:

Better learning results are expected when a teacher-led class is taught without presenting the contents using PowerPoint.

Method

Participants

A total of 205 students (n = 205) in their third course of psychology participated in this study, 143 of whom were females (69.76%) and 62 of whom were males (30.24%). All the participants were registered in the course on the Psychology of Education (compulsory in the Bachelor's in Psychology) during academic year 2010-2011. This course was taught by two professors, each of whom was assigned two groups. Thus, all the teaching in this course was divided into four groups (two in the morning and two in the afternoon).

Instruments

Hardware instrument. A computer with an Intel Pentium IV PowerPoint with 3,000 GHz and 4.00 GB of RAM was used, connected to an Epson LCD projector (EMP-8300) with XGA resolution (1024*768 ppp) supported up to UXGA (1600*1200).

Software instrument. A total of 19 slides designed and presented using the Microsoft Office PowerPoint 2003 programme were used. According to information gathered in other studies (Blokzjil & Andeweg, 2005), we took care that the number of lines on the slides did not exceed 13 and that the number of words varied between 42 and 93, as can be seen in the sample slide below (figure 1).

After a period of reflection and preparation, the two professors in charge of the course jointly prepared the content of the 19 PowerPoint slides.

Evaluation instrument. The teachers also designed a ten-item multiple-choice test to evaluate the knowledge acquired by the students. All the questions and their possible answers were directly related to the contents previously taught in the class session and were part of one of the subjects taught in the course on the "Psychology of Education". Each item had four possible answers, only one of which was correct. Each correct answer was scored as one (1) point and each incorrect answer was scored as zero (0) points; the students were informed about the scoring procedure. All the questions were oriented at information recall.
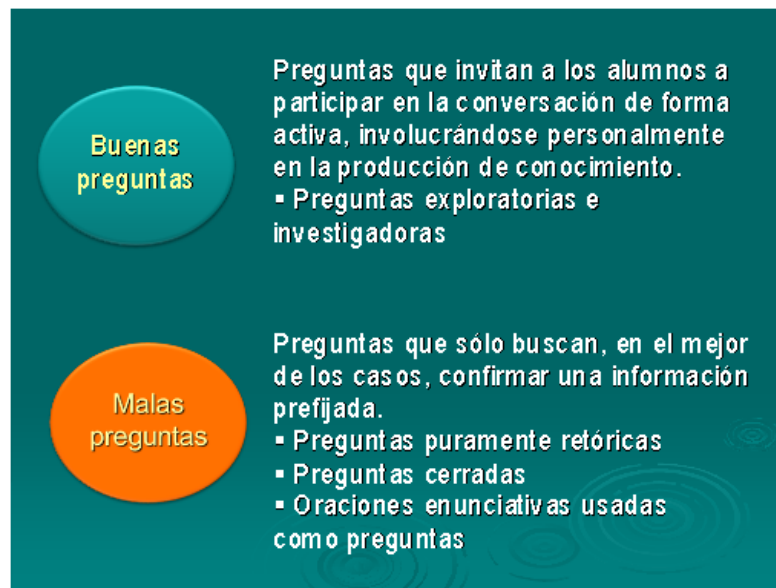
Figure 1. Sample slide

Procedure

The experimental phase was part of an ordinary class taught by the professors in charge of the course. In this way, the professors also played the role of experimenters. The four experimental sessions were held on the same day (Thursday) at different times, since one professor taught classes in the morning and the other in the afternoon.

With the goal of neutralising the possible effect of the order in which the different methodologies were used (with and without PowerPoint), it was randomly determined that one of the professors would begin by teaching his class supported by oral discourse without any kind of electronic support and would continue in his second class with the literal transcription of the information presented in the PowerPoint presentation, while the other professor would follow the opposite order in his classes.

The students had no knowledge that they were being subjected to an experimental test in any of the four sessions, since all the conditions led them to believe that it was an ordinary class similar to the classes taught until then and the evaluation activity had been scheduled in advance. These experimental sessions were taught halfway through the course.

Each of the class sessions lasted 40 minutes in order to give students enough time at the end (15 minutes) to answer the questionnaire. The students were informed that they would be given a questionnaire to evaluate the knowledge they had acquired in this class and that they could not use their notes or any other kind of material to complete it. Therefore, the evaluation situation was very similar to a conventional exam. Likewise, they were told that the evaluation was voluntary and anonymous, since its goal was to ascertain the degree of knowledge acquired globally, not individually. No student refused to answer the

questionnaire, so the number of questionnaires completed equalled the number of students present in those classes.

Design

For this study, a simple-blind design with independent samples was used. The 205 students were distributed in each of the four groups according to the section in which they were registered. Each professor in the course taught two groups. One of the professors had a total of 91 students (51 and 40), while the other had a total of 114 students (65 and 49). No significant differences were noted in the proportion of males and females among the four experimental groups.

Statistical Analysis

The responses were subjected to a multivariate analysis of variance MANOVA) with the goal of checking whether there were any differences between the measurements of the levels of each of the independent intergroup variables studied (professor and method).

The eta value was obtained in the partial square (η_{p2}) as a measurement of the size of the effect, considering that a partial eta-squared of .01 was small, .04 moderate and .1 large (Huberty, 2002) and the statistic on observed power. The calculations were performed using the statistical package SPSS/PC+ (version 15.0), and the statistical tests were bilateral with a type-I variable error at 5%.

Results

Multivariate analysis of variance (MANOVA)

The distribution of the sample according to the method used was 57% with PowerPoint and 43% without it. The distribution of the participants according to method and professor is shown in table 1 below.

Method	Professor 1	Professor 2	Total
With PowerPoint	51 (44%)	65 (56%)	116
Without PowerPoint	40 (45%)	49 (55%)	89
Total	91	114	205

Table 1. Number of participants by method and professor

The analyses performed with a MANOVA showed significant differences in the method variable [$F(1, 201) = 53.09$; $p = .000$; $\eta^2 = .209$]; specifically, the scores earned without the presence of PowerPoint were significantly higher ($p = .000$) in terms of the number of right and wrong answers. No significant differences were observed in the professor variable [$F(1, 201) = 3.23$; $p = .074$; $\eta^2 = .016$] or in the interaction between method and professor [$F(1, 201) = .94$; $p = .333$; $\eta^2 = .005$].

		Right answers	Wrong answers
Method	With PowerPoint	6.73 (.13)	3.27 (.13)
	Without PowerPoint	8.21 (.15)	1.79 (.15)
Professor	Professor 1	7.65 (.15)	2.34 (.15)
	Professor 2	7.29 (.13)	2.71 (.13)

Table 2. Mean and standard error of the right and wrong answers according to method and professor

Number of correct answers

The test comparing the means showed significant differences in the number of right answers between the groups taught using PowerPoint and the groups taught without any technological support ($p = .000$). As shown in figure 2 below, the number of right answers without PowerPoint is almost 1.5 points higher than the number of right answers in the classes with PowerPoint.
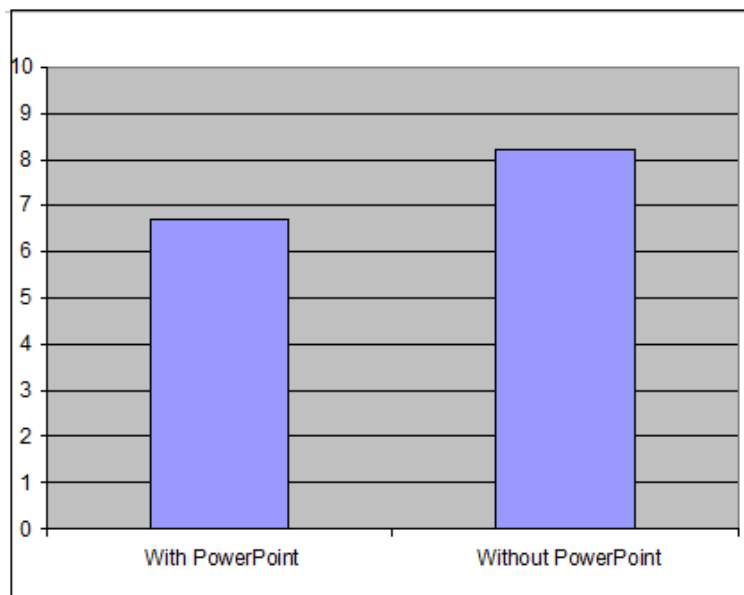

Figure 2. Average number of right answers according to the experimental condition

Number of wrong answers

Being complementary to the previous variable, the number of wrong answers dropped significantly when the contents were taught without PowerPoint (*p* = .000). Figure 3 below shows how the average number of wrong answers without the use of PowerPoint is 1.5 points below the number of wrong answers with the use of PowerPoint.
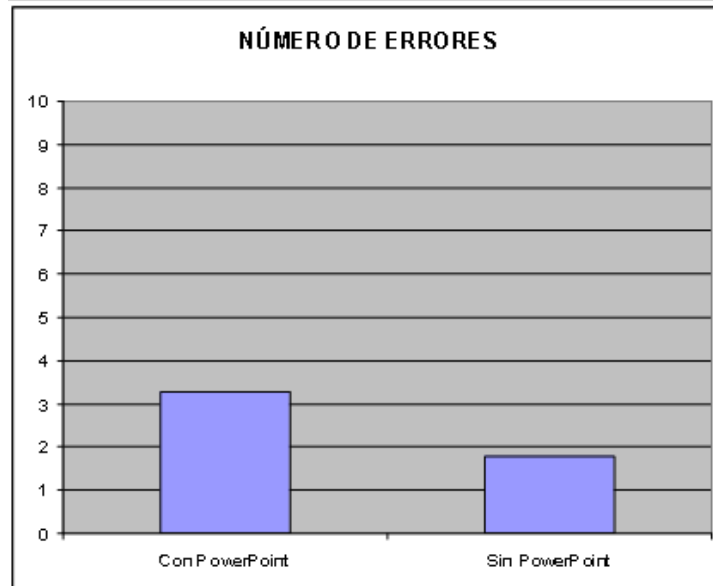

Figure 3. Average number of wrong answers according to the experimental condition

Results show how the evaluations of contents presented without PowerPoint yielded better results (more correct answers and consequently fewer mistakes) than when the same contents were presented using the PowerPoint methodology. The magnitude of the differences is 14.8% of the total scale (that is, 1.48 points over ten), and if we take the class taught without PowerPoint as a reference, the effect of this technology used according to the procedure described is to lower learning by 18%, which can be considered a significant effect (or defect).

These results are in line with the ones obtained by Amare (2006) and Erwin and Rieppi (1999), but opposite to those obtained by Moreno and Mayer (2002) and Blokzijl and Andeweg (2005). We should stress that the PowerPoint presentations were used as the core of the class, not as a complement to the teacher's action, which explains the contradiction with the second kind of results, as there PowerPoint was used as a complement to the teacher, instead of as the main means of presenting the content. In either of the two cases, the results indicate that PowerPoint helps students to become more focused on the material presented and the effects of technology itself (such as animations) than the teacher's discourse or, in the best of cases, students must divide their attention between the material projected and the teacher's comments. However, the most common scenario according to Driessnack (2005) and Savoy et al. (2009) is for students to focus on the material being visually presented, thus hindering

their comprehension of the verbal information that may be provided by the teacher (Szabo & Hastings, 2000).

Due to the procedure used, the following three points also come into play in explaining the results:

- Reading the material presented: It is assumed that whoever is listening is a competent reader. Reading what is displayed by slides can be done from any place other than the classroom. If the teacher limits himself or herself to presenting (or reading) what the students can already read for themselves, the information provided by the teacher becomes redundant, and thus either the teacher or the presentation becomes unnecessary (Cladellas & Castelló, 2010). In consequence, the teacher is not playing the role of facilitator of student learning, since he or she interacts with the projected material instead of with the people who are trying to learn it.

- The structure, flexibility and communicative possibilities of the oral discourse (accompanied by nonverbal resources) is not equivalent to those of the written format and even less so to a schematisation. When the goal is to replace well-articulated oral discourse with the display of contents via PowerPoint, there is a probable loss of information and context. The teacher's explanation, if it is well-constructed and fits the students' level of knowledge and understanding, goes far beyond the mere issuance of contents, which is what takes place with PowerPoint. For this reason, the class of a poor teacher can be taught with or without PowerPoint (or by a PowerPoint presentation, with or without a teacher), whereas a good teacher cannot be replaced by this technological resource.

- While the teacher is facing the PowerPoint, he or she has no contact with the students or audience, so that the feedback and adjustment mechanisms are disconnected from the listeners. Ultimately, when the teacher reads a PowerPoint, he or she tends to have a much more monotonous (and tiring) tone of voice and pace of talking than in a speech that is not read from a text. This monotony lowers students' ability to keep their attention focused and prompts the exhaustion of attentional resources and motivation in general, despite the fact that according to some authors (Susskind, 2005; Szabo & Hastings, 2000) the presence of PowerPoint is motivating for students since it provides security in terms of the contents that should be included in their notes.

At least two drawbacks are concealed behind this apparently positive motivational component: the first refers to the reification of the contents in the verbal expressions used, which is less likely in oral discourse, in which different utterances of the same content usually occur, with the meaning taking precedence over the signifier. The schematisation of the slides displaying

the verbal content turns the sentences into slogans, which is a reductionist approach to the contents to be explained. If the utterance (or slogan) is not understood, there is no alternative way to apprehend its meaning. The second drawback, partly caused by the previous one, is that student memorisation is accentuated to the detriment of their comprehension of the materials presented. Tacitly, student contact with the contents in which they must perform operations such as filtering, contextualisation and attribution of meaning (of either the teacher's discourse or the material read in an article or book) has been replaced by contact with a "distillate" of these contents, which is no longer susceptible to further explanation. Therefore, the only remedy is to memorise them (probably dogmatically). In any event, what is gained in student satisfaction is clearly lost in the quality of the resulting learning.

Discussion or Conclusions

Teachers' actions are not aimed at mere contact with the material; rather the critical aspects of these actions lie in facilitating learning interactively. If all learning consisted of engaging with (and ultimately memorising) contents, face-to-face classes would bring no added value to the process and instead would be a costly method of engaging in contact with these contents. As Neville (2004) notes, in some cases, a presentation made using PowerPoint can serve as a guide for the listener/reader, but it is never an element capable of replacing a good teacher. What is possible is that it can be used to conceal poor-quality teaching by providing apparent validity, albeit without gains in the resulting learning.

It should be stressed that only one way of using this technology has been considered: the kind in which the bulk of the class is supported by projections, leaving the teacher in a secondary role. The results were very clear in terms of the negative effects of this way of teaching. However, given the explanatory centrality of the displacement of the teaching action, in future research we should also explore the uses of PowerPoint as a complement (with either graphic materials or verbal information) to the instructional actions guided by the teacher. In other words, the results obtained do not shed light on the possible utility of this technological resource; they rather refer only to the negative effects of one way (although a fairly widespread way) of using it. Our intention, hence, is in no way to condemn the use of technology in general and PowerPoint in particular, since as Savoy et al. (2009) note, all software has its advantages and disadvantages. The use of technology can have a very positive influence on learning, provided that its use fits the circumstances inherent in learning at any given time, and efficient, flexible resources, like the traditional chalkboard and especially the flexibility and efficiency of a good education professional, are not sacrificed up to blind trust in the technological resource.

Finally, we should stress the lack of connection between students' performance and their preference for the use of PowerPoint projections. The sensible use of educational technologies

should find an effective balance between performance and preferences. Availability, familiarity or preference should not dictate the use of these technologies. The course material (that is, the kind of information) and goals are what should determine the use of resources that foster a learning environment that makes better student performance possible. To achieve this, teachers must be aware of their advantages and disadvantages, and we should avoid falling into the misapprehension, as happens in so many other realms of life, that what is used the most is assumed to be good and effective.

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