

ANALYSIS OF DIGITAL TEACHING TOOLS IN THE NEW EDUCATIONAL PARADIGM

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Abstract

Nowadays most high education professors use several digital tools to support teaching, such as education platforms and other sources like digital slides or digital documents. Most universities rely on their own educational platforms, which has been mainly used to share documents between professors and students. These platforms reinforce the master classes, but do not replace the typical face-to-face classes. For instance, the platform used by the Universitat Politècnica de València in 2006 is called PoliformaT and is an adaptation of Sakai. On this digital platform, professors and students can share and manage information and documents from their degree or master subjects, such as tasks, exams, content repository, etc. Due to the COVID-19 crisis, the high education professors forced to replace face-to-face classes by virtual classes, to confront the new educational paradigm that has emerged. Furthermore, they have had to deepen into the functionalities offered by existing platforms and to adapt their teaching to other types of platforms that allow virtual teaching such as Microsoft Teams, Google Classroom or Blackboard Learn. Therefore, because of the current situation and the potential that e-learning platforms and tools have in university teaching, it has led to the emergence of numerous software related to teaching. However, due to the short reaction time to adapt face-to-face to virtual teaching, no comparisons have been made between existing digital tools to define which of them is most appropriate for each university and its teaching style. Hence, a deep analysis of existing digital tools to support teaching is required. This paper aims to analyse and compare several teaching software tools. For that, the functionalities of the most used teaching tools are compared, and their main advantages and disadvantages are analysed in order to obtain the best tools to be used in high education.

Keywords: Comparative analysis, digital teaching tools, e-learning, higher education.

1 INTRODUCTION

Many digital and non-digital tools exist and have existed to support teaching in high education. In the past, professors used acetate slides on an overhead projector for their face-to-face classes. Afterwards, these acetate slides were digitized through computers, and the first digital slides were created with typical word processors and were processed to be shown to the students on a screen video projector [1].

Straightaway, the use of digital presentation tools such as Microsoft Powerpoint spread, and began to emerge teachers positioned for or against these teaching tools. For instance, opposing movements are based on the fact that digital tools limit the human interaction and that it is transformed into less retained information by students. On the other hand, the pro-movements indicated that using digital presentation tools produces more interest from students and helps to explain complicated concepts to students [2]. It should be noted that, to obtain benefit from the use of digital tools, a set of good practices should be applied by both teachers for and against their use. Otherwise, we can fall into bad teaching practices that affect the well working of the face-to-face classes. Therefore, it is mandatory to use a teaching model in the classroom that uses the advantages of these digital presentations [3].

Following this trend of teaching digitalization, the high education has wagered on using digital platforms, open-source or commercial license, which serve to upload digital presentations used by professors during lessons in classroom, to share documents and audiovisual media between students and professors, or for professors to send the required activities among others. In this way, all the material for each subject can be shared to students and is accessible online at any time. These digital platforms are mainly used to share teaching material between professors and students, and are not designed to replace the face-to-face classes. An example of these platforms is PoliformaT, the platform used by the Universitat Politècnica de València in all their degree and master's degree. PoliformaT was created in 2006 and it is based on Sakai project, an open-source environment for

higher education [4]. On this digital platform, in addition to upload and share classes material, it has more features such as tasks, internal email, calendar, online exams, notices, forums or content repository. Also, PoliformaT belongs to the group of e-learning tools, computer applications and digital resources that help students and professors in the teaching subjects [5].

Until March 2019, different e-learning tools were used in Spanish universities, such as PoliformaT in Universitat Politècnica de València. These tools were used as support for face-to-face classes, never as a replacement for them. But, due to the COVID-19 crisis, the high education professors were forced to substitute face-to-face classes by virtual classes. However, the digital tools used until this moment were not designed for virtual classes. Although it is true that there has been an evolution from the overhead projector to e-learning tools, there was no preparation and time to confront the new educational paradigm.

In this respect, the solution of the Universitat Politècnica de València was to purchase licenses of the virtual teaching tool called Microsoft Teams. This new tool was used to replacing the face-to-face classes. Furthermore, in this new context, professors had two main tools, the well-known PoliformaT, which continued with the same functionalities/uses, and the Microsoft Teams tool, which was unknown to professors. In addition to Teams, there are other similar tools on the market such as Google Classroom or Blackboard Learn.

Hence, the aim of this paper is to analyse and compare existing digital tools to support teaching in the different Spanish universities. For that, first teaching staff from different Spanish universities were consulted through a survey, to identify the digital platforms used before and during the pandemic generated by COVID-19. Subsequently the functionalities, advantages and disadvantages of the most used teaching tools in Spanish universities were analysed.

The rest of the paper is organized as follows. In section 2, the methodology used to collect and analyse the digital platforms employed in several Spanish universities is described. The results of comparative analysis of support teaching high education tools are exposed in section 3. Finally, in section 4 conclusions of this paper are presented.

2 METHODOLOGY

To conduct the comparative analysis of the digital platforms used both before and during the pandemic generated by the COVID-19 in Spanish universities, the starting point is identified which are the employed tools. For that, a short survey was sent to several universities from Spain by email. A summary of methodology employed, with the main steps required to achieve the study of this paper is shows in Fig. 1.

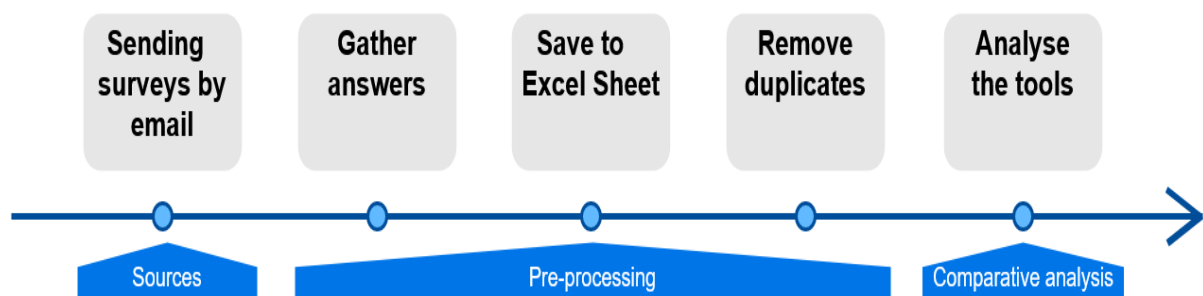


Figure 1. Steps of methodology.

The participants in this study are the different professors and researchers with teaching collaboration from Spanish universities. In particular, teaching staff from the following Spanish public universities have participated: Universitat Politècnica de València (UPV), Universidad de Sevilla (US), Universidad de Salamanca (USAL), Universidad de Cádiz (UCA), Universidad de Huelva (UHU), Universidad de Murcia (UM), Universitat de Lleida (UDL), Universitat de València (UV), Universidad Complutense de Madrid (UCM), Universidad de Jaén (UJAEN), Universidad de Castilla-La Mancha (UCLM), Universidad de Zaragoza (UNIZAR).

This produces a total of 12 participants with experience in both traditional teaching and the new teaching paradigm. These participants were given a survey via email to know about which digital teaching tools they used before and during pandemic.

Once the different answers of the questionnaire had been collected, the name and use of these digital teaching tools were stored in Microsoft Excel Sheets. Later, duplication of tools in Excel Sheets was deleted, that is to say, the same tools used in different universities were discarded. Finally, the result tools were studied in order to carry out the comparative analysis.

3 RESULTS

As indicated in the methodology in Section 2, the 12 participants in the study sent their responses via email. These responses were collected and pre-processed, obtaining the different tools for comparative analysis. The results of each of the main steps of the methodology (sources, pre-processing and comparative analysis) are described in the following subsections.

3.1 Sources

The first step was the creation of the survey asking to participants about which digital teaching tools they used in face-to-face classes (before pandemic) and virtual classes (during pandemic). Table 1 shows the questionnaire elaborated with the questions asked, which was later sent to active professors and researchers with teaching collaboration from several Spanish universities.

Table 1. Survey created and sent to Spanish high school teaching staff.

	<i>Pre-Pandemic</i>	<i>Pandemic</i>
Question 1. Digital tools or platforms used to support high school teaching		
Question 2. What are each of these digital tools or platforms used for?		

3.2 Pre-processing

Secondly, a total of twelve Spanish public universities replied to the survey by email. The answers collected and saved in Microsoft Excel Sheets. On one hand, related to the first question of survey, the digital tools or platforms and the type of license (open-source or commercial) identified of each participant are shown in Table 2. Most of the pre-pandemic digital platforms were tools adapted by the university with open-source software. And during the pandemic many of the tools that were added were commercial software.

Table 2. Answers to question one of Spanish high school teaching staff.

<i>University</i>	<i>Digital tools or platforms</i>	
	<i>Pre-Pandemic</i>	<i>Pandemic</i>
UPV	PoliformaT (own tool based in open-source Sakai)	PoliformaT Microsoft Teams (commercial tool)
US	Blackboard Learn (commercial tool)	Blackboard Learn Blackboard Collaborate (commercial tool)
USAL	Studium (own tool based in open-source Moodle)	Studium Google Meet (commercial tool)
UCA	Aula Virtual (own tool based in open-source Moodle)	Aula Virtual BigBlueButton (open-source tool)
UHU	Aula Virtual (own tool based in open-source Moodle)	Aula Virtual Zoom (commercial tool)
UM	Aula Virtual (own tool based in open-source Sakai)	Aula Virtual Zoom (commercial tool)
UDL	Espai Virtual (own tool based in open-source Sakai)	Espai Virtual Blackboard Collaborate (commercial tool)
UV	Aula Virtual (own tool based in open-source Moodle)	Aula Virtual Blackboard Collaborate (commercial tool)

UCM	Aula Virtual (own tool based in open-source Moodle)	Aula Virtual Blackboard Collaborate (commercial tool)
UJAEN	Espacios Virtuales (own tool based in open-source tool ILIAS)	Espacios Virtuales Google Meet (commercial tool)
UCLM	Aula Virtual (own tool based in open-source Moodle)	Aula Virtual Microsoft Teams (commercial tool)
UNIZAR	ADDUnizar (own tool based in open-source Moodle)	ADDUnizar Google Meet (commercial tool)

On the other hand, related to the second question of survey, the uses of each digital tools or platforms were identified. The responses revealed a similarity in the type of use between all universities, leading to two kinds, tools such as PoliformaT, utilized before the pandemic and mainly used as a repository for subject material, tests, notices, forums, and tasks; and tools such as Microsoft Teams, started to be utilized during the pandemic and mainly used for virtual classes and tutoring. This tool classification of each participant regarding to a type of use is described in Table 3. All the pre-pandemic digital platforms were used for share material, manage and evaluate the subject. Besides, all the added platforms during the pandemic were utilized for impart classes and tutoring of the subject through videoconferences and chatroom.

Table 3. Answers to question two of Spanish high school teaching staff.

	<i>Use of digital tools or platforms</i>	
<i>University</i>	<i>Subject material, manage and evaluation</i>	<i>Subject virtual classes and tutoring</i>
UPV	PoliformaT	Microsoft Teams
US	Blackboard Learn	Blackboard Collaborate
USAL	Studium	Google Meet
UCA	Aula Virtual	BigBlueButtom
UHU	Aula Virtual	Zoom
UM	Aula Virtual	Zoom
UDL	Espai Virtual	Blackboard Collaborate
UV	Aula Virtual	Blackboard Collaborate
UCM	Aula Virtual	Blackboard Collaborate
UJAEN	Espacios Virtuales	Google Meet
UCLM	Aula Virtual	Microsoft Teams
UNIZAR	ADDUnizar	Google Meet

Once all the tools and their uses have been identified, the tools to be analysed and compared are obtained. For that purpose, the same tools used in several universities will be discarded to avoid duplicates. In addition, platforms that are based on another platform, that is to say, the core/original platform will be analysed. A total of 9 tools was analysed, four with and open-source license and five with a commercial license, shown in Table 4. Of the nine tools, four were being used before pandemic and five started to be used during the pandemic.

Table 4. Tools to be analysed.

<i>Tools</i>	
<i>Open-source Tool (universities)</i>	<i>Commercial Tool (universities)</i>
Sakai (UPV, UM, UDL)	Blackboard Learn (US)
Moodle (USAL, UCA, UHU, UV, UCM, UCLM, UNIZAR)	Blackboard Collaborate (US, UDL, UV, UCM)
ILIAS (UJAEN)	Microsoft Teams (UPV, UCLM)
BigBlueButtom (UCA)	Google Meet (USAL, UNIZARI, UJAEN)
	Zoom (UHU, UM)

3.3 Comparative analysis

Finally, the nine tools were compared based on its main functionalities, advantages and disadvantages. In order to make the comparative analysis, the tools are divided into two groups, depending on the type of use, one group for the tools that used for share material, manage and evaluate the subject; and a second group for the tools that used for imparting virtual classes and tutoring.

Before the comparison, the study is contextualised with a short analysis with basic graphs. The aim is to obtain the tool that is most used in universities, rely upon the type of use, shown in Fig. 2. The most used tool is Moodle followed by Sakai in the first use group, both open-source tools. And, in the second use group, the most used tool is Blackboard Collaborate followed by Google Meet, both commercial tools.

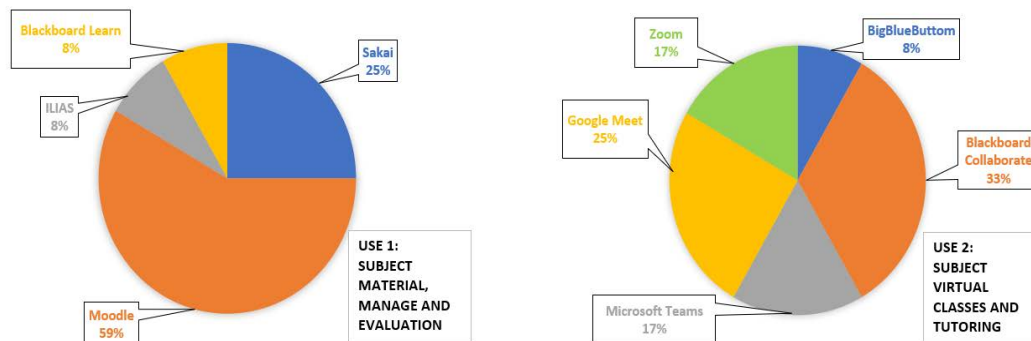


Figure 2. Number of Universities per tool depending on use.

It is also aiming to obtain that software acquisition guidance is being applied in the universities, rely upon on the type of use, demonstrated in Fig.3. In the first use group, there is a greater number of tools with an open-source license, however, in the second use group, is the opposite, there is a greater number of tools with commercial license.

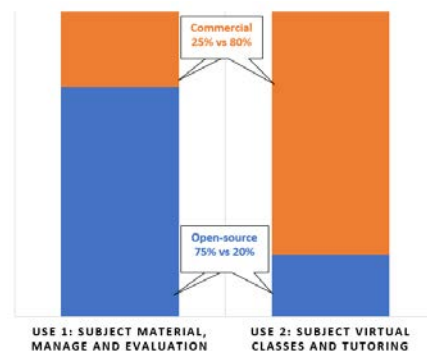


Figure 3. Number of Universities per type of license depending on use.

3.3.1 Comparative analysis for first use group (subject material, manage and evaluation)

The four tools to be compared are Moodle, Sakai, ILIAS and Blackboard Learn. In order to make the comparison, some basic criteria are required to evaluate any e-learning tool. For this purpose, has been used the study of Al-Ajlan [6], which defines some criteria for evaluating e-learning tools. This study groups the criteria into three large groups: learner, support and technical. Furthermore, these groups are divided into other subgroups, which are functionalities or attributes, the basic criteria to be evaluated. For instance, in the case of the first group (learner), it is divided into communication, productivity and student involvement. And within communication there are the basic functionalities/criteria such as discussion forums or file exchange/internal email, among others.

Therefore, it is necessary to identify such basic functionalities/criteria in each of the tools to be compared. The result of this analysis is a tie between Moodle, Sakai and Blackboard; and ILIAS the last because is left with less functionalities in relation to its competitors. Also, considering the

economic factor, that is to say less cost, it could be established Moodle and Sakai as first in the ranking. Because, in that case there is a disadvantage with Blackboard Learn for having commercial license.

3.3.2 *Comparative analysis for second use group (subject virtual classes and tutoring)*

The five tools to be compared are Blackboard Collaborate, Google Meet, Microsoft Teams, Zoom and BigBlueButton. As with the first use group, it is necessary to dispose some criteria for evaluating this type of tool, also called web conferencing tools. In that case, there is no study to rely on, so we have based on typical aspects virtual classroom should have such as: video conferencing, whiteboard, chat, file sharing, collaboration between students, record video call, screen sharing, among others.

For that purpose, the functionalities offered by each tool have been compared. The result of this analysis is a tie between Blackboard Collaborate and Microsoft Teams, because are the most complete tools. Regarding to Google Meet, Zoom and BigBlueButton, considering the integration factor meaning incorporation with tools the first use group such as Moodle, BigBlueButton integrates perfectly with Moodle or Sakai. Hence, it could be established Blackboard Collaborate and Microsoft Teams as first and BigBlueButton as second in the ranking.

4 CONCLUSIONS

In this paper, a comparative analysis has been made between different teaching software tools used both before and during the pandemic generated by the COVID-19 in Spanish universities. The results of the analysis have revealed that there are two main types of high education teaching tools, first group utilized before the pandemic and mainly used as a repository for subject material, manage and evaluation; and second group started to be utilized during the pandemic and mainly used for imparting classes and tutoring of the subject through videoconferences. Most universities before the pandemic had open-source licensed tools, but during the pandemic most of the added are commercial licensed tools, which is a significant change. This may be due to the short reaction time to adapt face-to-face to virtual teaching.

Regarding tools, the analysis has detected that it is now necessary to have these two groups of tools (subject material/manage/evaluation and Subject virtual classes/tutoring). In addition, the result obtained of best tools to be used in high education established Moodle and Sakai in first group used and Blackboard Collaborate, Microsoft Teams, BigBlueButton in second group used.

During the 2019-2020 academic year, teachers have had to abruptly adapt to these new digital platforms. However, it is expected that during the academic year 2020-2021 both teachers and students will have completed their period of adaptation to them, going from surviving in their use, to taking advantage of them. In this context, digital platforms can be used not only to share knowledge but to train students in various transversal skills.

To support this use of digital platforms, the School of Industrial Engineering from the Universitat Politècnica de València has created a website dedicated to the acquisition of transversal skills (<https://ctetsii.blogs.upv.es>). This website provides multiple audiovisual and documentary resources developed in the framework of different Educational Innovation and Improvement Projects (PIME), that can be a source of inspiration for teachers to work on transversal skills through digital platforms. At the same time, there are materials dedicated for students that allow them to advance in the development of these competences even in a virtual teaching environment.

In future works, this study can be completed with a more in-depth analysis of these digital tools to support teaching. Moreover, this study may also be extended in the future to include analysis from the point of view of use and satisfaction of several platforms or digital tools used in university. In order to check the adaptation of students and teachers to the new educational paradigm.

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