

DIGITAL EDUCATION PLATFORMS IN ENGINEERING: TEACHING AND RESEARCHING

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Abstract

This Digitalization has provided social transformation that opens up new chances in all living environment that also involves the education. This phenomenon arrives in teaching methodologies and how knowledge of teaching is processed. Nowadays, among the large number of digital tools the e-learning educational platforms are widely used for its versatility and for the information that it provides about the use of itself. Thus, digital technologies have deeply transformed both, the collecting data methods and the amount of data in the field of education research. In this work, we used a Web 2.0 e-learning platform with a large variety of applications (repository, content, news, forums, etc.) to encourage student satisfaction and motivation in the environmental engineering area. The platform provides a huge amount of data of its use such as number of visits, the average time of the visit, number of activities, number of tasks performed, and day of the week activity. However, a deep study of how the platform is employed by the students the strength and the weakness and the risks of this tool have not been done in this area. For that, this study is carried out in a subject named "Environmental Impact" that contributes 45h to the master degree of "Environmental Engineering" in the first year taught in the Universitat Politècnica de València (Spain). The most characteristic of this subject is the heterogeneous composition of the student since they come from different degrees, universities, ages, and knowledge. Thus, this exploratory empirical research aims to determine if there are different ways of uses of this e-learning methodology between students depending on their academic trajectory to optimize the tool. Data from the platform is collected and analyse applying the statistical methods such the analysis of variance in SPSS 16.0 to descriptive the starting point from which we began and to obtain answers to the preliminary hypotheses formulated about the use of the e-tools. The results show that the use of Web 2.0 fosters academic progress in the subjects taught due to the wide range of learning experiences. One of the most valued features by students is the freedom of the time and space dimension of the platforms. It is also found that the learning platform raises collaborative work between students increasing academic progress.

Keywords: Technology, research, education, science, platforms, university, statistic satisfaction.

1 INTRODUCTION

Masterclass-based learning has been the main teaching methodology in educational systems for decades. Although this methodology is highly effective at some key moments in the formation of the student, it is characterized by being rigid and inflexible and leaving no space to development any other activities [1]. Besides, research on this teaching methodology shows that student satisfaction is not high due to the low level of participation they have in the process [2]. Thus, in recent decades teaching methods have been transformed into newer methods that escape the limitations of space and time, and that respond to changes in society [3], [4], [5].

One of the main changes in this 21st century is digitalization, which has meant a revolution in all areas [6] [7]. Technological advances and data digitalization have had a fundamental and relevant impact on all social, political and cultural structures. And, of course, this impact also extends to educational models [8], [9] that have to adapt to the new teaching technologies (NTD). This transformation has been possible due to the development of Web 2.0 tools that have meant a change in the paradigm of how we use the Internet. Today, students are "digital natives" [10] who are used to using all the tools that the Internet offers to publish, share, relate and cooperate with other people [11] [12].

Good examples of these resources are blogs, wikis, social networks, youtube, Flickr, podcasts and virtual platforms. Among all of them, virtual platforms have become the most complete tools at the educational level since they allow the development of a wide variety of training modalities in which communication is a fundamental component [13]. Therefore, the platforms have become powerful learning tools since they allow the generation of a non-presential learning spaces that confer great

flexibility in space and time [14], [15]. It should be noted that the platforms allow both transmitting knowledge (traditional teaching method) and designing and planning experiences/learning spaces with the use of other methodologies.

However, although the use of these technological resources is promising, they are not effective if they do not have a well-planned educational purpose about the teaching process [16] and an assessment of their effectiveness. That is why it is necessary to carry out an information-gathering exercise simultaneously with the development of a subject applying NTDs, which will allow the evaluation and research about the process. The use of these NTDs has meant a substantial change in the research of teaching because it allows obtaining a great amount of information about the process and a huge amount of parameters in real-time. Therefore, it opens a way to raise new research questions about the quality of digital teaching [17] [18]. It is important to highlight that the change in teaching research is promising but caution is needed since these digital resources are not yet widely used by the teaching community so research on these techniques is still incipient.

The goal of any research on the use of these teaching tools is to improve the teaching-learning process and increase the level of student satisfaction, which is a key element for the success of the educational process [19] [20]. Satisfaction and positive attitudes increase interest in a particular subject and lay the foundation for acquiring new knowledge, generating a climate of self-confidence and self-assurance [21]. Furthermore, all this is done in a collaborative environment where contact is not lost with either the teacher or the students and in a very familiar format for the students, since nowadays even cell phones with their autonomy and discretion allow quick access to all these resources.

This paper aims to answer two questions. The first one is about how the use of NTDs can favor student satisfaction in a process of teaching a subject in the field of environmental engineering (pedagogical objective). The second one is about how we should approach the change in the research model in teaching, given the great amount of information that NTDs provide about the process. This fact makes it necessary to apply statistical research tools to extract as much information as possible and to be able to respond to the initial hypotheses.

2 METHODOLOGY

The research has been carried out in a compulsory subject named "Environmental Impact Assessment" with a teaching load of 4.5 credits. This subject belongs to the Study Plan of the Environmental Engineering Master, which is taught at the Universitat Politècnica de València and Universitat de València with 90 credits. Students access to the Master from several previous degrees such as Degree in Public Works Engineering, Degree in Chemical Engineering, Degree in Topography, Degree in Environmental Sciences, Degree in Agricultural Engineering, etc. The objective of the subject is to provide students tools to include environmental variables in the decision-making process in the engineering field.

The virtual learning platform under analysis is PoliformaT, from the Universitat Politècnica de València. It corresponds to a Web 2.0 site that allows the participation of all users (students and teachers) to share information about the subject with the possibility of using a multitude of tools. These tools are grouped into two types. The first one tools to manage the learning process with applications such as Resource Repository, Tasks, Contents, Online Exams, News, Calendars, Chat, Internal Mail, Discussion Forums and Polimedia. And, the second type are indicators of the use of the platform itself, such as the number of visits, an average time of visits, number of tasks, etc., which allows exploration and research on the tool.

2.1 Data collection

One of the main advantages of the use of these technologies is the acquisition of new forms of information and data collection beyond the classic procedures of teacher's observation. Since the use of educational platforms is not limited to the established time schedule but also outside, in private space, the process of collecting information is also continuous over time, which significantly increases the number of data available. Thus, various parameters are shown that provide information about both the characteristics of the students and the use of the platform used (Table1).

Table 1. NTD parameters used.

Students	Platform	
Age	Nº visit/student	Most used tools
Previous degree	Nº visit /day of the week, month, year	Most open resource
Gender	Total number of activities*/Student	Time average in platform/Student
	Times document open	Nº of tasks developed/Student

*activities: any action that the platform allows, such as creating, reviewing, sending or saving an assignment, grading and commenting on assignments, writing, sending, answering or deleting an email, editing and taking an exam, etc.

The platform allows selecting data for a given period of time (7 days before, 30, or from the beginning of the course) and different roles (student, teacher, or both). In this study, the data have been taken from the beginning to the end of the course period using student role. In addition, information about student satisfaction (about the experience, tastes, type of activities, and resources that have been used on the platform and their overall satisfaction) has also been collected through surveys. The answers by the student correspond to a 5-level rating scale (1.Totally disagree-5.Totally agree). An example of a survey is shown Table 2.

Table 2. N Survey of satisfaction in the use of NTDs.

<i>With the application of the NTD this course...</i>	1	2	3	4	5
...I involved in the subject					
...it has increased my satisfaction					
...group work has been encouraged					
...the learning has been more active and experiential					
<i>What I liked the most about the application of NTDs was:</i>					
The materials provided by the teacher (videos and documents used).					
The design of the activities in the classroom					
<i>In general...</i>					
I am very satisfied with NTDs					
I would recommend this experience to my colleagues					
I would like this methodology to be applied to the rest of the subjects					
<i>With the application of the NTD this course...</i>					
...I involved in the subject					
...it has increased my satisfaction					
...group work has been encouraged					
...the learning has been more active and experiential					

2.2 Statistical methods

In order to analyze the data from a large number of observations statistical techniques have been used. The techniques used for data analysis allow us to investigate the correlations that occur between educational phenomena in which multiple aspects or dimensions concur; the age of the student body, previous education, gender, etc. Identifying whether there is any relationship between these dimensions and the magnitude is fundamental, not only to reply to the initial hypothesis about satisfaction in the use of NDT, but also to achieve a certain degree of prediction.

Finally, the analysis of variance techniques have been used in order to address the research in which comparisons between groups are included. ANOVA (SPSS v.16.0 and Statgraphics Centurion XVII) has been used to compare the degree of satisfaction with the use of NTDs according to different factors.

3 RESULTS

3.1 Students characterization

It is necessary to examine the row data to identify any anomalies that could mask the final results. Table 3 shows the descriptive statistics of the variables studied related to the use of NTDs and the subject. As can be seen, the group of students is between 23 and 50 years old (average of 27). Half of them are between 20-25 years old, 38.4% 25-30, and 11.5% are over 30 years old. The 54% are women and 46% men.

Table 3. N Descriptive of the variables studied

	Age	N° visits	N° activities	N° open document	Time mean (min)	N° tasks	Aprov
Mean	26,8	62,7	169,7	38,4	82,7	21,8	7,7
Standard deviation	5,4	22,3	43,5	17,9	24,0	5,3	0,7
Min	23	12	5	1	33,6	5	6,4
Max	50	121	223	70	115,1	31	8,7
90th percentile	29,5	87,0	212,5	62,5	104,5	26,6	8,5

The "number of visits" to the platform is the parameter with the highest variation coefficient (35.5%). This platform uses and the learning experiences are designed to allow the student accesses both in the classroom time and in his private space. Thus, since this personal space is included the variability in the access to the platform increases. The use of the platform regarding the days of the week show that Monday and Wednesday are those with the highest activity (16%). However, on weekends this activity does not disappear but registers a lower number 12%. On the contrary, the "number of tasks" to be performed by students is the most homogeneous indicator, since all of them are required to pass the subject. The "number of tasks" that students perform each time is a good indicator of the progress of the subject. It shows that the workload involved in each access to the platform (activities) is not excessive and/or that motivation is high because they apply almost daily to it. These tasks are usually associated with polymedia videos, screencasts, or documentation in written text. The "number of tasks" designed for the course is 31. The results show that most of the students (90%), at the end of the subject have completed 87% of their tasks.

The "average time" reflects the time (min) each student spends on the platform throughout the semester. This information is important taking into account the student's profile today, since they are jumping from one activity to another and are usually connected to several networks simultaneously. Therefore, if they manage to keep their attention on a single activity, at least 30 min on average each time they access the platform, is a very encouraging result.

3.2 Students satisfaction

In order to investigate the use of the platform and the degree to which the application has influenced over the satisfaction of the learning process, bivariate correlations have been established. Table 4 shows those variables for which there is a statistically significant correlation.

Table 4. Determination coefficient. All correlations are significant at a level 0.05 bilateral

Parameters		R2
N° visits	N° activities	,367
	N° open documents	,157
	N° tasks	,401
	use	,275
N° activities	N° open documents	,510
N° tasks	Age	,230
Use	N° open documents	,171
	Mean time	,275
	N° tasks	,473
	N° activities	,701

The "Use" of the subject is significantly and positively correlated with the "number of tasks" developed on the platform (0.473). A wide variety of work tasks ensures that each student performs those training activities that encourage and promote the type of learning that best suits them (collaborative, meaningful, associative, receptive, observational, experiential, etc.) and therefore, the motivation to follow in the learning process is reinforced. The platform used in this study worked as a proper tool to host a variety of training experiences (readings, forums, video viewing, and screencast) along with various evaluation tools on the process.

In addition, there is a relationship between "use" and "no. of activities" that students perform (0.701). The types of activities offered by the platform are planned in an attractive way for the student with a similar interface to the social networks that they use in their personal lives so that allows providing lasting and meaningful learning experiences.

There is a positive correlation established between "no. of activities" and "no. of open files". This shows that each activity deals with different files and with different contents of the subject. This indicate the plurality of documentation (which can sometimes be a problem in certain areas of knowledge) hosted by the platform. When analysing the satisfaction of the use of the platform according to the different student profiles (age, formation, gender) it is observed that there are no differences either by gender or in any of the age ranges analysed.

Finally, the only statistically significant differences are found in the number of activities that students execute according to their previous formation. The students from a bachelor's degree and/or engineering usually carry out a relatively high average number of activities without any differences between them (neither age nor gender) (group 1 and 2) than those who comes from old study plans or from labour market (group 3). This may be because they come from educational systems with more traditional methods where the technologies applied to education had not been incorporated normally.

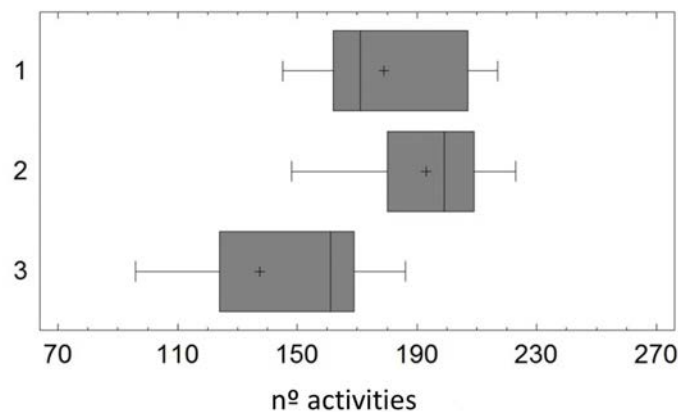


Figure 1: Number of activities according to previous academic training

3.3 Subject satisfaction

The degree of achievement and satisfaction of the student is highly related to the final grade obtained, although these two terms are not equivalent. To stimulate and promote this satisfaction, digital applications have been used to create new learning spaces and training actions, both inside and outside the classroom. However, the use of these new technologies in education required to analyze how these tools are incorporate to the student's routines in order to improve them continuously. Table 5 includes the results, expressed as percentages, of the questionnaires provided to students for this purpose. (1. Totally disagree-5. Totally agree).

Table 5. Results of the questionnaire regarding satisfaction in the use of NTDs

With the application of the NTD this course...	1	2	3	4	5
...I involved in the subject	0,0	0,0	6,7	33,3	60,0
...it has increased my satisfaction	0,0	0,0	13,3	40,0	46,7
...group work has been encouraged	0,0	0,0	0,0	13,3	86,7
...the learning has been more active and experiential	0,0	0,0	0,0	40,0	60,0
What I liked the most about the application of NTDs was:					
The materials provided by the teacher (videos and documents used).	0,0	0,0	13,3	13,3	73,3
The design of the activities in the classroom	0,0	0,0	6,7	40,0	53,3
In general...					
I am very satisfied with NTDs	0,0	0,0	0,0	13,3	86,7
I would recommend this experience to my colleagues	0,0	0,0	0,0	13,3	86,7
I would like this methodology to be applied to the rest of the subjects	6,7	13,3	6,7	33,3	40,0
With the application of the NTD this course...					
...I involved in the subject	0,0	0,0	6,7	33,3	60,0
...it has increased my satisfaction	0,0	0,0	13,3	40,0	46,7
...group work has been encouraged	0,0	0,0	0,0	13,3	86,7
...the learning has been more active and experiential	0,0	0,0	0,0	40,0	60,0

Results indicate that more than 80% of the students are believed to have increase in satisfaction with the subject. This may be due to the fact that 90% of them have been more involved in the process since they have been more active and therefore fostering significant learning. This follows the line of other authors who claim that the use of training platforms if good practices are carried out in them, increase student motivation when participating in activities [22].

The results show that the use of NTDs can promote teamwork among students (87%). This may contradict the general view that they isolate people. Virtual learning environments offer many possibilities for active collaboration processes [23]. It should be noted that, although all students are very satisfied with the use of NTDs, 21% of them are reluctant to implement them in other subjects. It seems that, although technology is completely established in their personal lives, in academic environments it is a resource that is not fully exploited by teachers, thus its use is still incipient and lacking of experience.

4 CONCLUSIONS

We are currently facing an era of teaching methods transformation as a result of introducing NTDs into the teaching-learning process. These technologies not only promote a change in the teaching procedure but also in the models of research in education. These technologies are intended to promote the training of students, increasing the quality of the process and, their satisfaction. This provides a familiar environment for a generation that are digital natives and removes spatial barriers. The information collected and analyzed revealed that students with conventional previous training use less the platform and therefore their level of satisfaction was lower. It was also determined that there was a no different use of the platform according to age ranges. In fact, it is demonstrated that online training through the use of well-designed platforms is suitable for anyone who is concerned about lifelong learning and not only for young people who are following the formal academic training [24] [25]. And last, the use of NTDs generates a dataset with a size and complexity greater than the traditional methods and therefore requires the use of more powerful statistical tools. This is essential to improve teaching within the framework of the guidelines set out in the European Higher Education Area. Identifying whether there is a relationship between these dimensions, and of what magnitude, is fundamental not only to respond to the initial hypothesis about satisfaction in the use of NDT, but also to be able to achieve a certain degree of prediction of these effects.

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