THE IMPACT OF CROSS-PLATFORM APPLICATIONS ON THE DIGITIZATION OF EDUCATIONAL INSTITUTIONS

Diana SCURTU[1], Roxana – Adriana PUIU[2], Gabriel PETREA[3], Alexandru IVAN[4]

Cross-platform applications have made substantial contributions to the digitization of educational processes over time, evolving with technological progress and technological innovation, culminating in the current pandemic context. This article examines the impact that this applications have on improving or even partially replacing current education systems by capturing the process of teachers and students understanding their actions and the environments in which the educational process takes place. In recent years, it has been found that cross-platform applications prove to be effective in both educational and industrial fields, given their accessibility and ease of use. In this sense, within the University POLITEHNICA of Bucharest, the UPB Campus application has been implemented, which helps students through centralization of campus information.

Keywords: cross-platform, education system, educational process

1. Introduction

The increasing quality of education on each level (primary, secondary, pre-university and university) is vital for a country's economic growth. In the academic year 2019/2020, a teacher had 15.4 students, according to the report prepared by the Ministry of Education. In the period of 2011-2014, the ratio between the number of students and the number of teachers decreased from 19 to 14.8 students per teacher. Starting with the 2015/2016 academic year, the ratio increased, reaching 15.5 in 2017/2018 and 15.4 in 2019/2020 [13].

Regarding pre-university education, by analyzing levels of study, the lowest ratio (10 students / teacher) is given by the secondary stage while the primary stage has the highest value (19 pupils / teacher). Analyzing the above data, it results that a teacher is responsible of 15 students on average with cases where this number is higher.

[1] Student, University POLITEHNICA of Bucharest, Romania, e-mail: diana_scurtu@yahoo.com
[2] PhD Eng., University POLITEHNICA of Bucharest, Romania, e-mail: mechnoroxana@yahoo.com
[3] PhD Eng., University POLITEHNICA of Bucharest, Romania, e-mail: gabriel.petrea@gmail.com
[4] Student, University POLITEHNICA of Bucharest, Romania, e-mail: alexandru.ivan11@gmail.com

Table 1

The evolution of the number of students enrolled in undergraduate studies, by forms of ownership

Year	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020
Total	**19**	**16.9**	**15.4**	**14.8**	**15.2**	**15.3**	**15.5**	**15.3**	**15.4**
Government Education	16.4	15.3	14.5	14.1	14.7	14.7	14.9	14.6	14.9
Private Education	35.2	26.6	20.5	19.9	19.9	20.6	20.7	21.1	19.8

Source: Ministry of Education, 2021 [13]

In this context, it is difficult for teachers to focus on the quality of education, especially in cases where they must engage in a vast number of questions, analyze individual activity, and present the information in a personalized way, depending on the needs and the level of knowledge of each student.

As a result, a series of applications have been developed to target these needs, initially for desktop and later integrated on mobile, which aims to facilitate the whole learning process, both from the perspective of the teacher and the students, offering flexibility, speed and, of course, an alternative to the traditional education system.

Educational technology, the category of the applications discussed above, can not only provide alternatives to traditional ways of solving homework, tracking progress, but can be an excellent solution for those who cannot physically attend school due to problems such as a disability or geographical area. More recently, digital education has proven to be essential in times of crisis, when access to classrooms is restricted or poses a high risk to teachers and learners.

The recent years have brought us a new standard for the educational process, traditional education and its online counterpart merged, being given the pandemic context in which we have been and will continue to be. Moreover, the usage of gadgets by students is becoming more and more indispensable [7].

The Romanian educational system, reluctant or not, has been “forced” to adhere to optimal digital solutions so that the students can continue to have quality education. Thus, there has been a “forced” improvement of resources in the process of teaching and learning, from human to material resources (gadgets).

In this context, it was easy to see the reluctance of teachers to adapt to the new form of education. For example, they believe that the new approach of including technology in the classroom or moving the classroom to each student's

laptop is more of an obstacle than a help. However, it is not the teachers' fault, as their reluctance stems from a lack of training.

The fact that lately the changes have been very dynamic, they either could not be provided with the necessary equipment and training, or it was made in a very short time. The trainer should be an expert in education, not a technical expert. With such a trainer, teachers can get explanations and examples of how to use technology in the classroom. During the training sessions, teachers would also have the needed time to practice the use of new technologies in an educational environment. On the other hand, many well-trained teachers are reluctant to use technology in the classroom because it is not built into the curriculum.

However, changes can already be seen in this context, as more and more teachers have started to move from classical to digital courses. The information is increasingly structured and organized, facilitating access to it.

The practical laboratory work has turned into computer simulation, which can be done by students later, after the course. Even the assessments have changed as more and more teachers are open to open book and grid examinations. The basis of all these changes were the platforms that the educational units made available to the teaching staff [4].

It will be important to understand that changes starting with technical and ending with policy issues should become effective in our education infrastructure. It will be up to the representative of each education institution and, at the same time, to the government to link the information with the educational system to become more and more adapted to our new lifestyle [1].

2. Related work

If will take a look intro the past years, there were many researchers who studied educational technology in order to improve the student learning. We can mention few names, like: Broadbent Donald Eric (1956), Severin Werner (1967), Mayer Richard (2009). Some others, like Annetta Leonard (2008), Hamlen Karla (2011) and Yarbro Jeff (2014) have been faced with different challenges in enhancing to use technologies to capture the students' attention in order to improve their engagement, motivation, and also learning itself [1].

Broadbent, even in 1950s', used to talk about attention as using similar information that are passing through a filter, are better to be understand [3]. Even in 1967, Severin considered that "an assumption of communicators using multichannel media seems to be that the more channels used to reach the receiver, the greater the amount of communication" [12]. In one of his articles, at the beginning of twenty-first century, Mayer talked about verbal and visual presentation forms used for learning, as being a better way of studying, due to the connection between the learning outcome and channel capacity [9].

During recent years, it has become clear that a modern class of students is increasingly filled with smart mobile phones, tablets, laptops, and other smart devices. These aspects have led to the successful development and implementation of cross-platform applications, from an educational point of view.

The differences between cross-platform and multiplatform applications are difficult to identify from the user perspective. This is due to the way in which applications are built from the software developer point of view. Multi-platform development involves creating an application that runs source code depending on the type of hardware and operating system. When creating a cross-platform application for iOS and Android, the developer must write code in Swift and Kotlin at the same time. On the other hand, in the case of a cross-platform application, the developer writes a single source code which, by various technical methods, is translated for the platform on which it is to run [5].

Cross-platform and multi-platform development have advantages and disadvantages, one being complementary to the other.

In present days, the number of educational institutions started to adopt solutions through which to digitize the educational process has been increased, revising, or even giving up to the classic educational system.

Among the solutions most often used by educational institutions we mention: VLEs (Virtual Learning Environments), MS Teams, MOOCs (Massive Open Online Course).

Virtual Learning Environments (VLE) is a set of educational and learning tools designed to enhance the overall experience of online education by implementing the latest technology. In general, VLE consists of the following components [6]:

- Tracking students and progress
- Tools for submitting and grading assignments or homework
- Courses for planning and managing courses
- Online support for teachers and students
- Online communication tools such as chat and group discussions

An example used at the POLITEHNICA University of Bucharest is the Moodle platform, integrated with MS Teams, through which teachers can organize their courses online and students have quick access to the information and tasks created. At the same time, through the online sessions, the communication is made in real time, there is also the possibility of recording and watching the courses later.

Regarding the online courses, in our university the students and high school students have access either to the courses recorded by teachers or to those on the Coursera platform, at the end of which they receive a certificate attesting its completion.

3. Platform's overview

The advantage of cross-platform development is in terms of production costs, which are significantly reduced compared to the costs involved in cross-platform development. Moreover, it is much more advantageous for developers in terms of time and level of work to opt for a cross-platform solution because they do not have to work in parallel on two or more versions of the same application. The disadvantage of a cross-platform developed application is that the mechanism by which the written code is run on any type of architecture / operating system, brings overhead, resulting in decreased application performance.

Multi-platform applications have the advantage of running at high performance because the written code is specialized for the architecture / operating system. This is also a great advantage when it comes to testing the application, making it much easier for developers to identify possible issues. The disadvantage of multi-platform development is the cost of production. The developer must write the source code for each type of platform. Moreover, the development time is longer than in the case of a cross-platform application [10].

In the context of the digitalization of university level education, the benefits of cross-platform development are the backbone of the decision to create applications for the centralization of educational resources. This is the example of POLITEHNICA University of Bucharest, which chose Dart language as the development medium for its application, UPB Campus, together with the Flutter framework. Flutter brings great benefits to developers by combining the benefits of cross-platform development with those of multiplatform development. Flutter allows the development for mobile, Android and IOS, but also for web applications. Thus, Dart is used by the developer to generate the source code, and from the Dart language, the code is translated into the source code for the target platform. For example, UPB Campus is written in Dart, and then, the code is transformed into source code in Swift language for IOS and Kotlin for Android. This approach has been successful in the context of developing applications for the university environment due to low production costs and limited time to be put into use [8].

In the current pandemic context, universities have had to make major changes in the way they manage and interact with students. Thus, the educational units that managed to adapt quickly to the current conditions are on higher ground by migrating the education in the online environment. In the present situation, the optimal solution for creating applications is the development of cross-platform, a fact that is marked by the release of UPB Campus. Thus, through its application, UPB offers [11]:

- Access to volunteer organizations within the university
- Ability to create and view time schedules

- Assistance to freshmen students in identifying buildings and classrooms on campus
- Access to the latest university news

Using the application, the university can monitor the user's activity, generating some statistical reports, as you can see in the figures below.

Source: UPB Campus Application

Fig. 1. Application's users displayed by their country

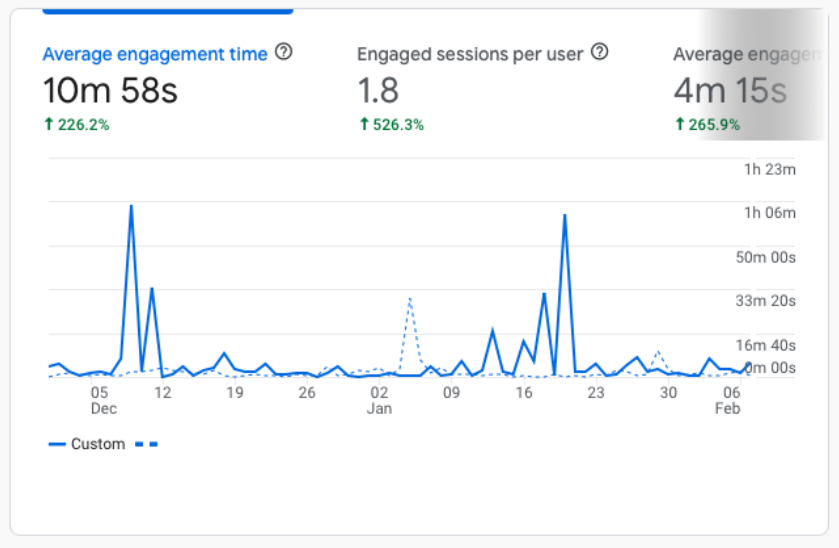
Another use of the application is that for each country we have detailed statistics which includes new users, engaged sessions, engagement rate and event count.

Moreover, through this platform we can download daily reports with the average engagement time for each active user.

	Country	Users	New users	Engaged sessions	Engagement rate	Engaged sessions per user	Average engagement time	Event count All events	Conversions All events
	Totals	276 100% of total	181 100% of total	615 100% of total	83.45% Avg 0%	2.23 Avg 0%	5m 29s Avg 0%	9,459 100% of total	172.00 100% of total
1	Romania	240	146	597	86.27%	2.49	6m 09s	9,129	141.00
2	(not set)	20	20	2	10%	0.10	0m 04s	124	20.00
3	United States	10	9	8	61.54%	0.80	2m 31s	95	5.00
4	Italy	2	1	2	100%	1.00	2m 43s	19	1.00
5	Turkey	2	1	2	100%	1.00	2m 16s	38	1.00
6	Germany	1	1	0	0%	0.00	0m 08s	7	1.00
7	Indonesia	1	1	3	75%	3.00	1m 21s	37	1.00
8	Ireland	1	1	1	100%	1.00	0m 00s	4	1.00
9	Malaysia	1	1	0	0%	0.00	0m 04s	6	1.00

Source: UPB Campus Application

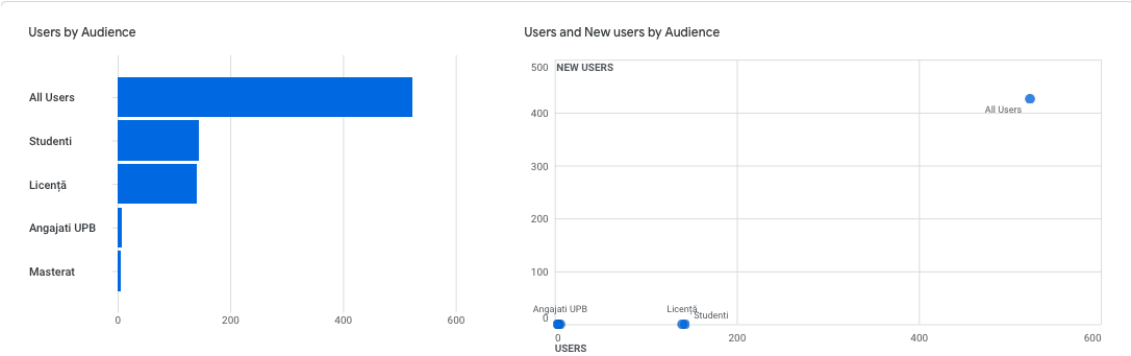
Fig. 2. Application's users displayed by statistics which includes new users, engaged sessions, engagement rate and event count



Source: UPB Campus Application

Fig. 3. Daily report regarding the average engagement time per active user

Another functionality of the application is to send customized notifications for users, triggered by their interests' topics, groups and events.



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Audience	Users	New users	Engaged sessions	Engagement rate	Engaged sessions per user	Average engagement time	Event count All events	Conversions All events	Total revenue
Totals	522 100% of total	426 100% of total	2,487 100% of total	75.85% Avg 0%	4.76 Avg 0%	22m 16s Avg 0%	44,293 100% of total	430.00 100% of total	RON0.00
1 All Users	522	426	1,145	76.85%	2.19	9m 03s	19,100	403.00	RON0.00
2 Studenti	143	0	657	75.43%	4.59	23m 27s	12,099	14.00	RON0.00
3 Licență	140	0	620	75.15%	4.43	23m 33s	11,441	13.00	RON0.00
4 Angajati UPB	6	0	33	71.74%	5.50	29m 46s	957	0.00	RON0.00
5 Masterat	4	0	28	71.79%	7.00	11m 22s	571	0.00	RON0.00
6 Elevi	3	0	4	50%	1.33	6m 39s	125	0.00	RON0.00

Source: UPB Campus Application

Fig. 4. App's notifications for users

Each user in application can be in at least one of the following categories: Bachelor Student, Master Student, PhD Student, Teacher, UPB Employee, Parent, or pupil. In this way, the University can monitor the activity of each area of interest. Thus, the rise of a university in the ranking is also based on the digitization of the educational process. The application can be accessed from web browsers, but also it has a mobile version, for the second option the advantage will be that the users will receive notifications on their devices each time when an event occurs. In this context, the universities that offer digital solutions will be much more to the liking of students and employees, so it is much more likely that they will be chosen by students, with a rise in the rankings.

According to figure 4, out of the total number of users, the students most willing to use the application are the students enrolled in the undergraduate study cycle, followed by high school student interested in applying in the future.

If the first category uses the application to locate classrooms, read the latest news from the university and to communicate in volunteer associations, high school students use the application to find out the latest information related to admission process.

4. Future perspectives

As perspectives for the future, cross-platform applications, same as learning and teaching tools, will help to improve the overall experience of online education through the implementation and continuous improvement of modern technologies, regardless of whether the scenario is exclusively online education, or exclusively physical education, or, why not, hybrid. As functionalities, the following will be considered:

- Monitoring the pupils / students in terms of the activities carried out, but also of the progress achieved;
- Providing online support for teachers and their students, regarding the planning and management of courses;
- Tools for implementing evaluation and grading systems;
- Possibility of online communication, through accounts;
- Use of virtual libraries containing information from academic journals, videos, pictures, podcasts, and so on.

Such applications will be used not only at the educational level. They can be used more and more often in medicine, engineering, and so on. The major impact will remain, however, at the educational level, especially in the situation when schools cannot be physically available to pupils / students [2].

In the future, the trend will be to develop applications independently of the educational platform, which are easier to use via smartphones. However, it is much more challenging than the realization of e-learning applications today.

5. Conclusions

The university governance plays a central role in adapting to the new educational context. As everything is digitized, the requirements for teaching and learning new skills requires a major educational transformation, with an emphasis on using external devices or applications. An example should be developing educational applications, where the lessons to be both attended, physical or online by students or their teachers, and developing applications for each subject, in order the class to be more attractive and interactive. Thus, university governance must provide policies and mechanisms for teachers to participate in internal and external educational programs and research. This can also be done when the university connects to the local and international educational network. By choosing to implement cross-platform applications, universities not just provide the ground for all the above listed, but also choose a more efficient and cost-effective manner of development for their internet portals.

Finally, deciding to digitize the educational process helps not just the university better integrate in the worldwide educational environment, but also students to be productive, by centralizing their needs.

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