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Digitalization in Education: Case Studies on the Implementation of Students' Developments in the Educational Process

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ABSTRACT
Project-based and problem-based learning is gaining popularity in technical specialties in institutions to ensure the digitalization of the educational process, which leads to the emergence of new software solutions. But only a small part of student developments are actually implemented and used. In this paper, an attempt is made to identify criteria for the success of student projects and problems that arise during development. It helps to understand how to increase the implementation rate. For this purpose, students' Case study developments were implemented in the educational process. And the authors made a survey of Case study developments creators. Developers were asked questions about their applications, development, implementation, and problems encountered. Based on the results of the survey, a list of criteria was compiled that affect the success and failure of a student project. It included motivation, support from the university, readiness of the university to change, availability of the necessary data in a convenient format, access to them, the ability to continue the project after the student graduates from the university, the ability to use the created application as a basis for projects in other universities, the competence of the team and effective project management. It is noted that some of these points can be influenced from a technical point of view.
Keywords: *Digitalization, research, education, case study, project, problem-based learning, student*

1. INTRODUCTION

Nowadays the educational process for technical specialties is becoming more and more practice-oriented. Students have to solve educational problem situation, perform analysis, design, coding and testing of results. [1] Such learning is called problem or project-based. And it leads to the emergence of new software solutions [2].

The university makes a great contribution to student development [3]. And students, in their turn, implement new projects based on received knowledge. Obviously that the university needs digitalization to improve the efficiency and quality of the educational process [4]. Thus, applications to improve the work and optimize university processes are among the most valuable for the educational institution itself. [5].

The problem is that despite on impressive number of implemented solutions, only a few of them are really provided to the real consumer.

In order to determine the criteria for success/failure of the implementation of student development in the educational process, it is advisable to conduct some research of existing developments or case studies [6]. Case - an example taken from a real business, is not just a truthful description of events, but a single information complex that allows you to understand the situation [7]. Case study is a method of research based on learning by analyzing a specific situation (case). [8]

Thus, the purpose of the work is to find cases of implemented applications, to conduct Case Studies on them in the form of analyzing the application and interviewing their creators, to make the conclusion and answer to the following questions:

- Why are some applications being implemented, while others are not?
- What problems do developers face? Is it possible to solve them?

2. METHODOLOGY

During the research Case study was performed on 20 students' implementations. The creators of 7 of these applications were interviewed. Developers were asked 10 questions about their applications, development, implementation and problems. According to the results of the survey, list of criteria that affect the success or failure of the student project was created, problems that students have to face were identified.

3. RESULTS

The search for applications was carried out in three ways.

1. Researching the applications of your university

2. Survey among friends
3. Search by university name in search engines, news feeds [8, 9], social networks and market places (App Store, Google Play)

a. Top 10 best Russian universities in international rankings for 2018 [10]
b. Best IT-universities in Russia [11]

This work focuses on the development of students for the educational process. Therefore, the list of applications was filtered accordingly. It includes only those developments that were created by students. The final list consisting of 20 applications is given in table 1.

Table 1 Cases of the introduction of student development in the educational process

Application	Functions	University
ITIS Portal 402	Wiki for University Schedule	Kazan Federal University
Telegram bot with schedule	Schedule	Kazan Federal University
Schedule	Schedule	Kazan Federal University
Student SFU	Schedule Lost and found SFU campus map Ads Urgent notifications News	Siberian Federal University
RGGU	Schedule Semester schedule Audience card Ordering books from the library News and announcements	Russian State University for the Humanities
MGTU Schedule	Schedule	Moscow State Technical University
YuurGU Online	Schedule News feed Jobs Campus map	South Ural State University
Applicant RF	Information about universities and faculties, their developments University and Faculty Reviews University Map Search for a suitable specialty	South Ural State University
HSE app	Schedule Search by students, teachers, classrooms, groups Create deadlines Filter free audience	High School of Economics (Moscow)
Raspisashka	Schedule	Novosibirsk State Technical University
TSU.InTime – schedule	Schedule	Tomsk State University
TSU Helper	Creating applications for university services	Tomsk State University
Auditorium 2.0	Collection of video materials from lectures	Moscow University of Physics and Technology
TPU Applicant	News, Events Progress Rating Reference Information	Tomsk Polytechnic University
Endowment Fund MISiS - be aware	Events that can be visited at a discount or free for students of MISiS	National Research Technological University "MISiS"
EdCrunch	Conference app Materials Communication with speakers	National Research Technological University "MISiS"
ITMO University	Schedule News, Events Information about faculties, staff Map of buildings and dormitories	Information Technologies, Mechanics and Optics University (Saint Petersburg)
Schedule IITU	Search by groups, classrooms, teachers Schedule	International University of Information Technologies

The development of timetables turned out to be the most widespread topic, the second place was taken by news feeds and useful materials. Indeed, the schedule and news is what the student uses every day, and their presentation is not always convenient. It is likely that this is what motivates students to create such applications.

Unfortunately, based on the applications themselves, it is difficult to determine the specifics of their implementation.

Therefore, the creators of the listed applications were searched for and surveyed among them.

4. DISCUSSION OF RESULTS

Survey for app creators
The survey was able to get a response from 7 developers. They were asked 10 questions:
1. When was your application released? How quickly did it develop? How many active users does it have?
2. How much time did you spend on development?
3. How many people participated in the development? Do you support your application now?
4. What motivated you to develop and implement the application?
5. Have you been given any help with the application of the university / faculty?
6. Where do you get data for your system? How is the acquisition and storage of data organized? - depending on the application, which data can be strengthened
7. Does your application integrate with third-party services? How is it implemented?
8. Do you have any other applications implemented at the university? What kind? Are they related to your application?
9. How did the process of implementing your application? What difficulties did you encounter?
10. A significant part of the applications created for the university by students does not reach production. Why do you think?
Consider the application, from the creators of which the distance to get an answer.

1) YuurGU Online

Mobile application "YuurGU Online" for the South Ural State University includes a fairly extensive functionality: the schedule, news feed, a list of vacancies and a map of the campus. There are versions for Android and iOS operating systems. At the moment, more than 80% of students use the application - about 13,500 people.
The creator of the application said that the test version of the development was released back in 2013. It immediately interested the students, in accordance with which it was decided to develop it further. The project's functionality has evolved slowly due to the limited amount of human resources and the lack of financial resources. The application was developed by the initiative of students who wanted to leave behind something useful. 6 people took part in the development. The interviewed creator has been involved in the application for all 6 years of study at the university and continues to support him to this day.
After a while, the student project turned into a business. At the moment, developers are creating similar applications for other universities. They note that using their development as a basis, you can quickly create an application for any university.
For data storage, developers use their own servers. To obtain the necessary information (for example, timetables), direct interaction with universities is carried out, part of the data is obtained through official APIs. From third-party services, the application uses authorization via the Vkontakte site, sending confirmation SMS and Google maps. Currently, the application "YuurGU Online" is the only one at the university.
During the development of the application, the creators had to face only local problems: the unreadiness of the university and staff for change.
The criteria that influenced the successful implementation of applications, and the problems faced by the developers are listed in Table 2.

Table 2 Success criteria and problems in developing the “YuurGU Online” application

What contributed to the introduction and success of the application	What problems had to face
Motivation - the students wanted to leave behind something useful	Limited amount of human resources
The application can be used as a basis for creating projects in other universities	Lack of financial resources
Continuation of the project after graduation from the university due to the transformation of the project into a business	Unwillingness of the university and staff to change

2) SFU schedule

The first version of the SFU Schedule application for Siberian Federal University appeared under the Android operating system in November 2014. After some time, there were versions for iOS, Windows Phone, as well as a website. There were about 2000-3000 users.
Until 2014, the schedule of the university was presented in the form of an Excel spreadsheet. The creator of the application notes that such a format was extremely inconvenient, which led him to develop. The project involved 3 people: 2 developers and 1 manager. They were motivated by the opportunity to benefit people.

Data for the application was obtained from the official site and updated in the database manually every six months. After graduation, students stopped supporting the project due to lack of funding.
The creator of the application notes that he has repeatedly observed such situations. The application is successfully implemented and functioning, but only as long as the developers are students and are motivated to support it.
The criteria that influenced the successful implementation of applications, and the problems faced by the developers are listed in Table 3.

Table 3 Success criteria and problems in developing the “SFU Schedule” application

What contributed to the introduction and success of the application	What problems had to face
Motivation - students want to benefit people	Inconvenient (unstructured) data format
	After graduation, students stopped supporting the application

3) Schedule MGTU named after N.E. Bauman

Mobile application "Schedule MGTU” was created for the Android operating system as a term paper. Half a year was spent on development, 3 people participated in it. The main problem was the lack of data in a convenient format, since before that the data were stored in a poorly structured format in the Excel spreadsheet. Work was done with the people who filled this table earlier. The creator of the application as well as the developer of “YurGU online” notes the unreadiness of the university for changes. After graduation, the developer stopped supporting the project.

Table 4 Success criteria and problems in developing the MSTU Schedule application

What contributed to the introduction and success of the application	What problems had to face
Motivation - submission of course work	Inconvenient (unstructured) data format
	After graduation, students stopped supporting the application
	University's unwillingness to change

4) Raspisashka

The mobile application "Raspisashka" for the Novosibirsk State Technical University includes both a ready schedule for several universities and the ability to create your own schedule. Its feature is the automatic transfer of a mobile device to silent mode during training pairs. The version exists only for the Android operating system.

The first version of the application was released in October 2013. Development took about 2 months. The creator of the application notes that his development went until the summer of 2015, while he had enough time to deal with them. He was motivated by the inconvenience of the schedule on the NSTU website and the need to automatically turn on the silent mode on the phone during the classes.

According to Google Play, the application has 18,000 users. The developer reports that not all users are students of the NSTU, as the application provides for entering the schedule manually, which makes it possible for other universities to use it. After some time, the schedules of other universities were added to the application.

The developer receives the data by automated analysis of the pages of the NSTU site. Data is stored in the cloud storage, with which the application is synchronized at the request of the user. The rest of the application is completely autonomous.

Of the difficulties, the developer had to face a little experience in creating applications. Getting this experience was one of the design goals.

The creator of the application "Raspisashka" considers that applications are often created only as part of a term paper or a thesis, without the intention to develop it further. In addition, production implies relatively high quality, reliability, constant support and error correction, and students often have no experience in industrial development. In his opinion, this is the reason why a significant portion of such applications are not being implemented.

Table 5 Success criteria and problems in developing the «Raspisashka» application

What contributed to the introduction and success of the application	What problems had to face
Motivation - the inconvenience of the existing solution and the desire to acquire new skills	Lack of industrial development experience
The application can be used as a basis for creating projects in other universities	

5) RGGU

The RGGU Mobile app for the Russian State University for the Humanities has a wide range of functions: you can find out the timetable, schedule of semesters, view a map of the audience, news and announcements, order a book from the university library. There are versions for Android and iOS operating systems.

The application was released in 2014. It grew out of the competition of student initiatives within the Crash Test University, which was won by the developers. After the competition, the active phase of the project began with the support of the university. Thanks to the active promo company, almost all students of the RSUH quickly learned about the application, and it immediately became popular.

During the active phase of development, about 7 people worked (classmates and the administration of the university), after which 2 people remained on support.

Data for the application is collected from the university database (for the library) and directly from the site (for the schedule). Difficulties arose with access to this data.

Table 6 Success criteria and problems in developing the “RGGU” application

What contributed to the introduction and success of the application	What problems had to face
University support	Access to university data
Participation of the university administration in the development and implementation	
Active promo company	

6) HSE app

The HSE app for the Higher School of Economics in Moscow is also multifunctional. It includes a search by students, teachers, classrooms, groups, allows you to create deadlines and quickly search for free audiences.

The creator of the application reports that the first version was released under the iOS operating system on September 12, 2017. In January 2018, the HSE Bot (chat bot) was launched on Vkontakte social network.

At first, the project team consisted of three people: a manager-designer, a Backend developer and an iOS developer. In November, the Android version was launched and an Android developer and testing engineer joined the team. The team has been actively working since August 2018 and continues to do so to this day: it is engaged in supporting, integrating new functionality, correcting errors.

The creation of the application motivated the state of the infrastructure of the university at the time of the start of development and dissatisfaction with the official application of the university.

The university took the project in two ways: from one directorate, the developers met with resistance, and the second provided information and material support.

The data are taken from the HSE study schedule system and are aggregated on the developer server to speed up the work. Part of the infrastructure is based only in the application itself and is not connected with the university. There is integration with the VK API in the case of HSE Bot and authorization by code from the students' corporate email.

In parallel with the “HSE app”, the “My Tower” application is being developed. Technically, it has nothing to do with the application in question and is its competitor.

The biggest problem the project faced was getting data from the system that belonged to the university.

The developer of the application believes that student development is often not implemented due to lack of experience in the implementation of products. It is the products when the processes of development, testing, product marketing and receiving feedback are built. In such projects, it is necessary to test hypotheses, learn the name to properly manage. Projects need to be developed in their spare time, and when students or graduates go to work in large companies, they do not have time to develop third-party projects.

Table 7 Success criteria and problems in developing the HSE app

What contributed to the introduction and success of the application	What problems had to face
Motivation - dissatisfaction with the official site and university infrastructure	Resistance of one of the directorates of the university
Support one of the directorates of the university	Retrieving data from a university system
Experience implementing products from developers	After graduating from university, students have no motivation to support the project
Finding a replacement for graduates	

7) ITIS Portal 402

The mobile application for Android and iOS “ITIS Portal 402” was developed by students of Kazan Federal University as project work on the subject of Project Management. It included 2 modules: timetable and knowledge base (“Wikipedia” for the university). A whole group of 15-20 students took part in the project. The development took one semester - about 4 months.

Support for the application after the delivery of the subject is not planned. After the end of the subject, the project worked for half a year, and problems began to arise when changing data. One of the students, the user of the application, took him to the support, but did it for long. Now application is not functioning.

Data for the schedule parsed from the table in Excel format. Its structure was ambiguous, and therefore a number of problems arose. The knowledge base was a separate module and did not have integrations.

Table 8 Success criteria and problems in developing the ITIS Portal 402 application

What contributed to the introduction and success of the application	What problems had to face
Motivation - the delivery of the project within the subject	Inconvenient (unstructured) data format
Effective project management	Lack of support for the application after the end of the course

Criteria affecting the introduction of student development in the educational process

The survey revealed that not all embedded applications are currently supported (table 9). Some of them are in the stage of active development, while others are no longer used. Obviously, unsupported applications can be considered less successfully implemented compared to supported ones.

The survey of developers helped to identify the following criteria that affect the success of application implementation (the criteria for the considered applications are shown in Table 10):

- Motivation for implementation. All the developers interviewed mentioned that they were motivated to implement applications. Five of them wanted to benefit people and the university, to raise the level of their knowledge. One project was completed with the aim of passing coursework. One - in order to get a grade on the subject. The last two applications are not supported. Unfortunately, students who are developing a project with the aim of taking the job and getting an assessment are not motivated in its implementation and further support. Such projects often do not bring any real benefit to the university. A possible solution to this problem may be the presentation of the results of activities in a format in which it will be possible for other students to use them.
- Support from the university. University readiness for change. Only 2 developers surveyed received support from the university in developing and implementing the application. Both applications have been successfully implemented and have a large number of users. Two applications met with vehement resistance, due to the university's lack of readiness for change. The solution to this problem can be a digital representation of university entities and open access to them.
- Availability of necessary data in a convenient format. 5 developers surveyed encountered the problem of lack of necessary data for the application in a convenient structured format. The solution to this problem can also be a digital representation of university entities.
- Access to the necessary data. 3 respondents faced not only the problem of data format, but also access to them.
- The possibility of continuing the project after graduation from the university. The project is doomed to failure if the student developer does not have a receiver or motivation to work on the application further. A possible solution to this problem may be the presentation of the results of activities in a format in which it will be possible for other students to use them.
- Ability to use the application as a basis for projects in other universities. In this case, the project becomes a business decision. 2 of the considered cases have such a concept and are relatively successful.
- Competence of the team and effective project management. Indeed, students do not have sufficient industrial development experience, but it is for the purpose of obtaining it that problem and project training is applied. Probably the secret of success is the properly built process of such training.

Table 9 Applications created by interviewed developers

№	Application	Supported now
1	YuurGU	yes
2	SFU Schedule	no
3	MGTU Schedule	no
4	Raspisashka	yes
5	PGGU	yes
6	HSE app	yes
7	ITIS Portal 402	no

Table 10 Criteria affecting the implementation and success of the project

	1	2	3	4	5	6	7
Motivation for implementation (not only for the delivery of the project in the framework of the subject, course work, etc.)	+	+	-	+	+	+	-
University support	-		-		+	+	
University's readiness for change	-		-		+	+	
Availability of necessary data in a convenient format		-	-		-	-	-
Access to necessary data					-	-	-
The possibility of continuing the project after graduation from the university	+	-	-			+	-
The ability to use the application as a basis for projects in other universities	+			+			
Team competence				-		+	+
Effective project management				-		+	+

5. CONCLUSION

During the project and problem-based technical education, new solutions for digitalization of learning process are emerging. But only a small part of them is really being introduced for production.

Successful use of microservices for project and problem based learning is impossible without the following components:

• motivation from student developers;
• readiness of the Institute for digital representations of University entities;
• availability of necessary data;
• access to important information;
• possibility to continue the project after graduation;
• ability to use the app as a basis for projects in other Universities;
• the competence of the team and effective project management.

Some of these points can be influenced from a technical point of view. A possible solution to the problem of support from the university and its unwillingness to change, the problem of the lack of necessary data in a convenient format can be solved with the help of a digital representation of university entities. And the use of the created application as a basis for digitalization implementation projects in other universities can be solved by presenting the results of activities in a format in which other students can use them. The implementation of such a concept may be possible with the help of microservices, each of which will represent the results of the work of one project. And one microservice can be allocated for the implementation of the digital representation of the main entities of the university and access to them.

REFERENCES

[1] N.G. Ugur, Digitalization in higher education: A qualitative approach, in: International Journal of Technology in Education and Science (IJTES), 4 (1), 2020, pp. 18-25.

[2] Guzel Rinatovna Eremeeva, Ekaterina Vladimirovna Martynova, Farida Bizyanovna Sitdikova, Ibaa Haidar, Massive Open Online Social Learning Environment For English Elearning System, in: Revista San Gregorio (ISSN: 1390-7247; eISSN: 2528-7907). No. 20. Special Edition. December 2017, pp. 6-13. DOI: http://dx.doi.org/10.36097/rsan.v5i20.506

[3] R. Dreer, Application of the principles of design education in undergraduate programs [Primenenie principov proektnogo obrzovaniya v programmah bakalavriata], in: Higher education in Russia, № 2, 2013, pp. 46-49.

[4] A. Blinov, O. Rudakova, E. Blagireva, Interactive methods in the educational process. Tutorial [Interaktivnye metody v obrazovatel'nom processe. Uchebnoe posobie], in: Publishing house "Scientific library", 2014, 120 p.

[5] Saiful Islam, Nusrat Jahan, Digitalization and Education System: A Survey, in: International Journal of Computer Science and Information Security (IJCSIS), Vol. 16, No. 1, January 2018, pp. 70-73.

[6] Satish Marathe, Digitalization in Education Sector, in: International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Special Issue. International Conference on Digital Economy and its Impact on Business and Industry, October 2018, pp. 51-56. URL: http://www.ijtsrd.com/papers/ijtsrd18670.pdf

[7] E.N. Ryabinova, L.A. Marchenkova, On the issue of the relevance of the formation of verbal competencies of students of technical universities [K voprosu ob aktual'nosti formirovaniya verbal'nyh kompetencij studentov tekhnicheskih VUZov], in: Bulletin of the Samara State Technical University. Series: Psychological and Pedagogical Sciences, № 2, 2015, pp. 173-179.

[8] V.A. Volkov, The role of the engineer in modern society [Rol' inzhenera v sovremennom obshchestve], in: New science: theoretical and practical view, № 5-2, 2016, pp. 168-170.

[9] News feed of the South Ural State University [Electronic resource]. - Access mode: https://www.susu.ru/ru/news, free (access date: 02/18/2020)

[10] News feed Siberian Federal University [Electronic resource]. - Access mode: http://news.sfu-kras.ru/, free (access date: 02/18/2020)

[11] List of TOP-10 best Russian universities in international rankings for 2018 [Electronic resource]. - Access mode: https://moeobrazovanie.ru/top_10_luchshih_rossiiskih_vuzov_v_mezhdunarodnyh_reitingah_2018.html (call date: 02.28.2020)

[12] List of the best IT-universities in Russia [Electronic resource]. - Access mode: https://studyinrussia.ru/actual/articles/it-vuzy-rossii/ (appeal date: 02/28/2020)