Analysis Of Students' Learning And Achievement Based On Data From The University Information Systems

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Abstract – The coronavirus pandemic upended almost every aspect of life. Education has undergone significant changes. The need for online teaching has emerged. Several questions have arisen as to how effective online teaching is; what are the advantages and disadvantages? This paper analyzes the impact of student attendance and activity on the learning outcomes of students as well as a success during online and regular teaching. The paper analyzes the downloaded log files from the Microsoft Office 365 portal for the used programs Microsoft Teams and Microsoft Forms and the log files from everyday activities from University Information System – UIS in North Macedonia. Using the Python application the data obtained from the University Management System – UMS are extracted about the achieved success of the students. Additionally, log files for student activities are downloaded from the Microsoft portal.

Keywords: E-learning, Online Learning, Learning analytics, Microsoft Teams, Microsoft Forms, University Information System.

INTRODUCTION

The transfer of knowledge or education is almost equal to human history. The history of e-learning is diverse, filled with success stories from the early 1900s and success stories from the 2000s [1]. Until the 80s of the previous century, the classical education era of lecturers lasted -1983 [2]. Between 1994 and 1999, the first wave of e-learning began to be used. With the development of Internet speed, LAN, wireless Internet, and the advent of Web 2.0 in 2000, the second wave of e-learning began. The emergence of mobile phones and the Mobile Web application in 2008 and HTML 5 in 2010 should also be emphasized, which have made a great contribution to the development and use of e-learning [3].

LMS is a multi-user software application usually accessed through a web browser [5] This application manages distance learning, self-study courses, and mixed learning programs. Provides automation that replaces rigorous and expensive manual work, saves time, and allows content, data, and students to be organized in cyberspace. This application also monitors and reports on the activity and training results of a particular course.

LMS grew out of a series of multimedia and internet developments in the 1990s. In the last four years, the systems have matured and been adopted by many universities worldwide. LMS are scalable systems that can be used to support university-wide learning and learning programs [6]. With the development of LMS, the need for learning data analysis has emerged.

In recent years, there has been a growing interest in automated data analysis to enhance the learning experience, a research area called learning analytics [4].

Learning Analytics (LA) has attracted a great deal of attention in recent years as educational institutions and researchers increasingly see LA's potential to support the learning process. LA approaches share the movement from data to analysis to action to learning [7].

Olga Viberga's analysis shows that the field of LA is still a developmental area of practice and research in which descriptive studies and methods of interpretive data collection predominate, according to Papamiciu and Economid (2014) [8].

The use of student data by AU institutions calls into question students' privacy. Kyle M., with a developed model, argues that students should be more informed about how their institution uses recognizable data and information and what it ends up with and gain purposeful controls over the flow of information. This proposed awareness and consent model ultimately supports student privacy and autonomy [9].

Mihaela Cocea and Stephan Weibelzahl analyzed the educational institution log files and assessed the level of student motivation. According to them, a prediction module should be set up in the basic systems [10].

Information from the International Vision University in the Republic of North Macedonia is used in this paper. The University has a University Management System, which students, professors, and student affairs use. In the following articles, the University Management System will be called UMS. UMS generates data or log files from everyday activities. Microsoft Portal 365 is used during the online teaching, from which the applications Teams, One Drive, One Note, Forms, etc., are used primarily.

From the data obtained from the University Management System - UMS, using the Python application, information is extracted about the achieved success of the students (obtained grades). Additionally,

log files for student activities are downloaded from the Microsoft portal from the admin panel. The paper analyzes the impact of student activity on success during online teaching in the summer semester 2019/2010 academic year and the winter semester 2020/2021. The paper also analyzes the difference between success in online learning and regular learning during the 2020 and pre-2020 pandemics.

The rest of the paper is structured as follows. The second section describes the used system in online education. In section III the used research methodology is explained. The results of data analyses are present in section IV. The final section gives concluding remarks and points out some directions for future works.

II. SYSTEM USED IN ONLINE EDUCATION

University Management System

This research used information from the UMS from the International Vision University in Republic of North Macedonia. UMS brings together the common data of university students and faculty members for their intended purpose. Combined data is processed without compromising relational integrity, resulting in significant results. The results from the data processing are prepared as a report. With user role management, data security is ensured, and the data accessed by each role is limited. Microsoft technologies are widely used in the UMS infrastructure. UMS using C #, Asp.Net MVC, MSSQL, HTML, CSS, Bootstrap, Jquery, and Javascript technologies is hosted on Internet Information Services (IIS).

University Management System (UMS) is a web-based application developed with the C # programming language, .Net Framework MVC, which supports users with disabilities. UMS is composed of several modules: Student Management System, Academic Information System, Student System. These modules are interconnected, and the goal is to assist the student service of the academic staff - professors, students, and the administration for the successful implementation of the educational process at the University. Another example of support for users with disabilities where the interface is made with WCAG 2.0 standards, a screen without many objects and elements so as not to confuse users with disabilities are given in the paper [11].

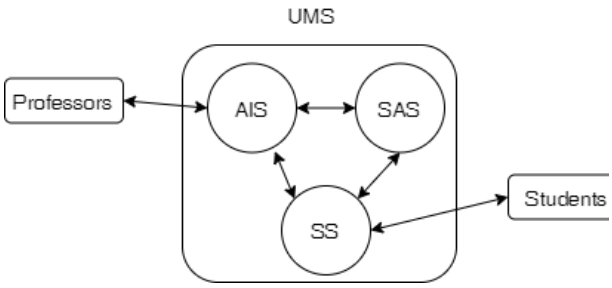

Figure 1- University Management System

Microsoft Portal 365 as an LMS

During the 2020 pandemic, teaching took place online. Online education took place with the Microsoft Portal, mainly with the Teams application. In addition to this application, One Drive and One Note applications are used, from where students download the materials set by the professors for their subjects. During the exams was used Microsoft Forms application was used with Microsoft Teams (Figure 1).

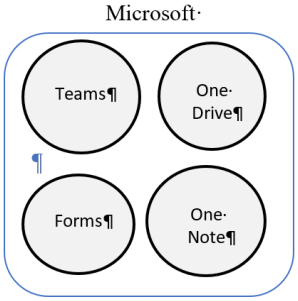

Figure 2- Microsoft LMS.

III. METHODOLOGY OF SCIENTIFIC RESEARCH

The LMS used at the University consists of two parts. The first is the University Management System - USU explained in more detail above. It can use AIS, students can download or follow from the SS portal or upload to One Drive. The second part is Microsoft applications in the Portal 365 package such as Teams, One Drive, Forms, and One Note. As can be seen from the picture, professors and students can log in to both systems with the same username and password. The professor can decide where to place the materials for the lesson they teach.

Microsoft applications are interconnected, ie, the material placed in One Drive can be easily shared on One Note or Teams. Every action of the professor in AIS, such as posting materials, comments, or messages to students, writing grades are visible in the Student System (SS), i.e., the student can see/access them. Also, the new data are ready to be used in the reports by the Student Affairs Service in SAS (Figure 3).

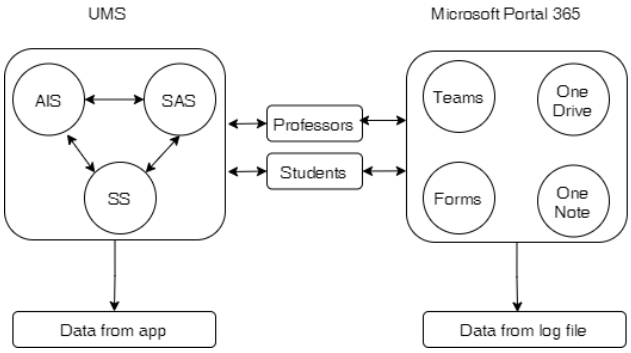

Figure 3 - Used LMS at the University

AIS - Academic Information System

SMS - Student Management System

SS - Student system

Evaluation

Our goal in this research is to analyze student achievement-related activity. The following figure (Figure 4) shows the database from which the data and log files are taken. The data are taken from a university in North Macedonia.

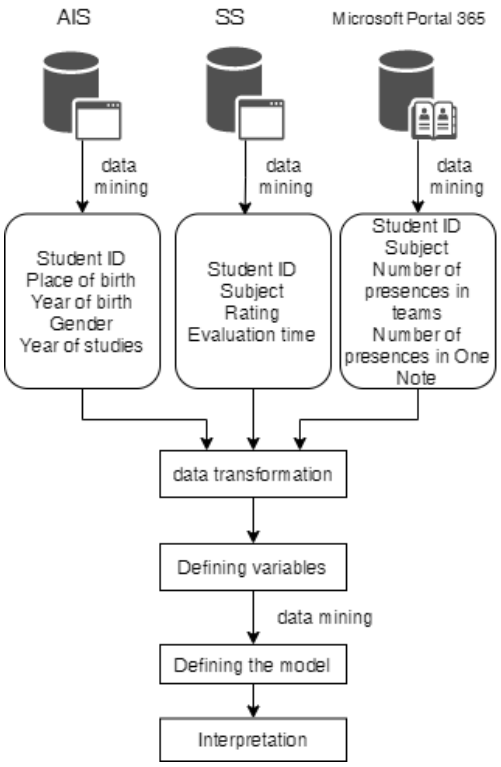

Figure 4 - Data model

The data Student ID, year of birth, gender, and year of studies are taken from SUS. From AIS, we extract the Student ID data and, with this ID, related grades received by the students, subject, and time of assessment (Figure 5).

	A	B	C	D	E	F	G	H	I
1	Numara	Ad	Soyad	EPosta	Cinsiyet	NotYil	NotDonem	DersPlanYil	DersPlan
48848	5304/19	Premtim	Mulaj	premtim.mulaj@vizyon.edu.mk	1	2019	2	2019	2
48849	5304/19	Premtim	Mulaj	premtim.mulaj@vizyon.edu.mk	1	2019	2	2019	2
48850	5307/19	Arife	Türkmen	arife.turkmen@vizyon.edu.mk	2	2019	2	2019	2
48851	5323/19	Nurcan	Sucubaşı	nurcan.sucubasi@vizyon.edu.mk	2	2019	2	2019	2
48852	5323/19	Nurcan	Sucubaşı	nurcan.sucubasi@vizyon.edu.mk	2	2019	2	2019	2

Figure 5 - Grades from AIS

During the online teaching, the regularity and activities of the students are registered, and that data can be downloaded from the Microsoft portal (Figure 6).

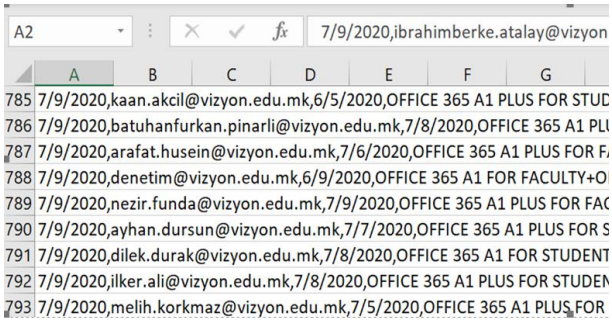

Figure 6 - Regularity of students

Using applications during the pandemic (Figure 7)

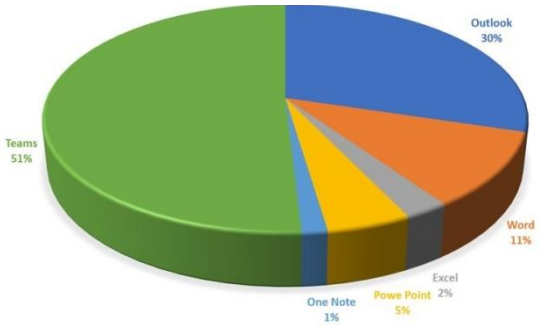

Figure 7- Percentage of applications used

The data is analyzed in the Python programming language. Python is a high-level scripting language, interpreted, interactive, and object-oriented. Python is designed to be very readable. It often uses keywords in English, where other languages use punctuation and have less syntactic structure than others [12].

Python aims to be the most powerful and flexible open-source data analysis/processing tool available in any language. Data mining can also be done with Python, and any kind of analysis of this data can be performed. But to use Python, you need to know a certain level of programming.

For Python visualization, must install special packages. One of the most important packages is the Panda package [13].

The Panda package provides fast, flexible, and expressive data structures designed to make it easier and more intuitive to work with "relational" or "tagged" data. It aims to be the primary blockchain for conducting practical, realistic data analysis in Python.

IV. Data Analysis

The data analysis is explained below.

1. The downloaded data from Microsoft Portal and UMS are merged first. From SMS, we take the data Student ID, gender, and year of studies. From AIS, we extract the data Student ID, exam grades, subject, and assessment time. We merge the two tables into a new file called IlkerQuery.csv shown in Figure 18 - AIS Ratings. Data on student attendance and activities (Figure 6 - Student regularity) can be downloaded from the Microsoft Admin panel and saved under Teams4.csv.

This achieving in the following way. The following codes are writing in the Jupyter editor:

```
import pandas as pd
from matplotlib import pyplot as plt
```

We are importing pandas and matploit packages.

```
df1=pd.read_csv('Teams4.csv')
df2=pd.read_csv('IlkerQuery.csv')
df1a=df1.set_index('user')
df2a=df2.set_index('user')
```

This procedure combines the data needed for analysis. CSV files downloaded from UMS, from Microsoft Portal are imported in df1 and df2 modifications. The index is defined in both files.

```
df3=pd.merge(df1, df2, how='right')
```

We merge the data with a right join.

```
[4]: type(df3)
Out[4]: pandas.core.frame.DataFrame
```

D	E	F	G	H	I	J
EPosta	Cinsiyet	NotYil	NotD	DersPlanYil	DersPla	DersAc
mesut.koca@vizyon.edu.mk	2	2019	2	2019	2	Araştırma
nilgun.aydemir	2	2019	2	2019	2	Araştırma
nurcan.sucubasi@vizyon.edu.mk	2	2019	2	2019	2	Araştırma
premtim.mulaj@vizyon.edu.mk	1	2019	2	2019	2	Araştırma
suat.eyuboglu@vizyon.edu.mk	1	2019	2	2019	2	Araştırma
yasemin.sabani@vizyon.edu.mk	2	2019	2	2019	2	Araştırma
turgay.sarac@vizyon.edu.mk	1	2020	1	2020	1	Sosyoloji

Figure 8 - Merged data

2. After merging the data, various processing and analysis can be done on them. The impact of the activity and regularity on the achieved success of the student was analyzed.

```
plt.plot((df3.MeetingCount+df3.CallCount), df3.YuzlukNot, '.')
plt.xlabel('aktivnost')
plt.ylabel('uspeh')
plt.show()
```

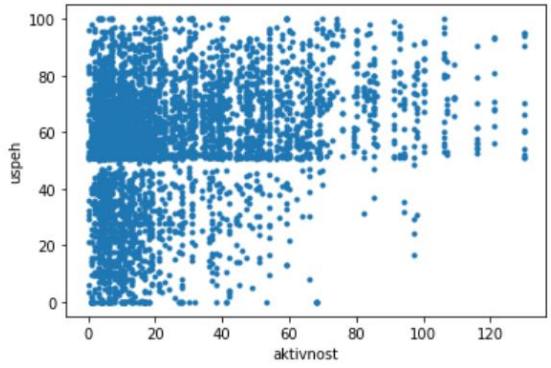

Figure 9 - Graphic representation of the results

The following code is used to extract success at a given time. In the example, the grades in 2019 are filtered for the second half.

```
df4 = df3[(df3.DersPlanYil==2019.0) & (df3.DersPlanDonem==2.0)]
```

```
plt.plot((df4.MeetingCount+df4.CallCount), df4.YuzlukNot, '.')
plt.xlabel('aktivnost')
plt.ylabel('uspeh')
plt.show()
```

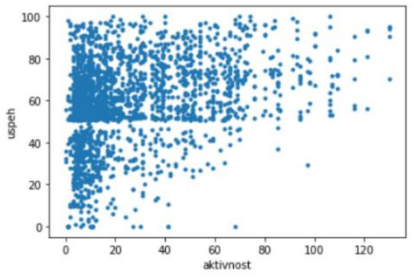

Figure 10 - Success at a given time

To calculate the average, we write the following codes:

```
import array
plt.xlabel('aktivnost')
plt.ylabel('uspeh')
EnYuksekDeger=int((max(df4.MeetingCount)))
print(EnYuksekDeger)
for i in range (0,EnYuksekDeger):
    df6=df4.query("MeetingCount == @i")
    if df6.YuzlukNot is None:
        df6.YuzlukNot=50
    avg=mean(df6.YuzlukNot)
    plt.scatter(i,avg,c='blue')
plt.show()
```

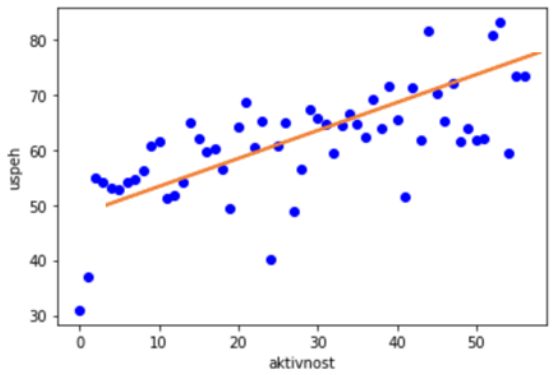

Figure 11 - Mean

The result of the examination, whether there is a connection between the activity and the success of the students, is shown in the graph where the regularity/activity is represented on the x-axis and the achieved success of the students on the y-axis (Figure 11). From the graph, we can see that there is a positive relationship between activity and success. That is, by increasing the value of regularity/activity, the value of success increases. Regularity/activity has a positive impact on student success.

In order to investigate the impact of our platform - UMS and the weight of the conducted exams. In addition, the distribution of student success during teaching online was analyzed. The results of the online exams were downloaded from UMS and Microsoft platforms in csv format. The downloaded results were processed in the Python programming language with the following codes.

```
In [2]: import seaborn as sns
        import pandas as pd
        import numpy as np

In [3]: df1=pd.read_csv('Teams4.csv')
        df2=pd.read_csv('IlkerQuery.csv')
        df1a=df1.set_index('user')
        df2a=df2.set_index('user')

In [4]: df3=pd.merge(df1, df2, how='right')

In [10]: sns.distplot(df3.YuzlukNot)
```

When processing the exam results, the following graph is obtained (Figure 12).

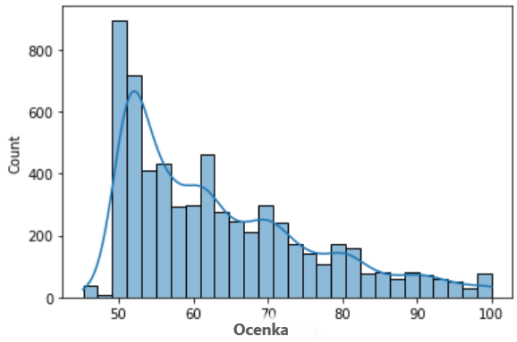

Figure 12 - Distribution of grades

In the graph, we see that the distribution is distorted on the left: Arithmetic mean ≤ median ≤ fashion. According to the results, teaching is appropriate; in other words, students achieve the goals planned in the curriculum. Exams are of the proper weight. This distribution results following the mastery learning model are observed (i.e., all students' material is scientific). The learning level of the students is good.

The second research in this paper is shown in Table 1. Given the success achieved before and after the pandemic with Covid-19, as we can see from the table of our University, there is no significant decline in the average success of students which we can conclude that the UMS system provides us with an opportunity in the successful implementation of teaching at MUV (International University Vision)

Table 1. The success of exams at Vision International University.

	Пред COVID-19	**Пост COVID-19**
Valid	2806	2592
Missing	908	1122
Mean	61.78	59.11
Std. Deviation	11.214	19.659

V. CONCLUSION

In the most intensive period of digitalization with the development of the USU system, we also aim to respond to the University's needs and give a new meaning to the data being processed. The USU system provides many data from parameters such as course records, group courses, student records, and staff records. Our system is a web-based application with its practical application, and students are provided access from anywhere in the world where they have a connection to the Internet. Also, thanks to the web-based approach, this system provides easier access to students attending courses through distance education and online learning.

In applying the UMS system, strengths and weaknesses have been identified and some issues that are requiring further research. Such a software solution helped us a lot in the realization of the curriculum during the COVID-19 pandemic. Our software application had a positive effect on the realization of the teaching and educational process at our University.

Based on the data we received from the university system and the research we have done with these data, we can say the following: There is not a big difference in students' success between face-to-face education before the pandemic and online education during the pandemic period. Students' success is better in face-to-face education, but there is not a big difference, which shows that it makes sense to apply online education during the pandemic period.

During the pandemic, we calculated the continuity of students' participation in online classes in different periods. We calculated the duration of each student's involvement in the course and the grade he received from that course. We noticed this: As the time to attend class increases, poor grades decrease. This means that participating in online classes increases success.

The problems that arose during the application of the UMS system were related to the inadequacy and weakness in the skills for digital competence of the academic staff and students, and the adaptation process lasted three weeks.

One of the essential findings we have identified is that teachers need to be given more practice to prepare exams in the Microsoft Forms forms and publish the exams on time. There was no problem with the connection during the realization of the exams.

The recommendations of this research are as follows: the students should attend online classes for better success; the teachers should pay more attention to online exams, the questions should be timed, a pool of exam questions should be created, and questions will be randomly selected from the question bank; the management and educators should use the results of the data analyses.

This research also raises some questions that require further study such as: What type of courses in online education gives better exam results? What types of exam questions provide better results? How does multimedia affect students' abilities and instructors' ability to teach?

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