23.2022

iJIM

International Journal:
Interactive Mobile Technologies

Papers

Table of Contents

Papers

Adoption of Distance Education and Mobile Technology by University Students

https://doi.org/10.3991/ijim.v16i23.36205

Seidaliyeva Gulnara Orazbekovna[1(✉)], Seidaliyeva Gaukhar Orazbekovna[2], Darkhan Ydyrysbayev[3], Gulnar Zhakypbekova[4,3], Bakhyt Sydykhov[5]
[1] Kazakh National Agrarian Research University, Almaty, Kazakhstan
[2] University of International Business, Almaty, Kazakhstan
[3] M. Auezov South Kazakhstan University, Shymkent, Kazakhstan
[4] Abai Kazakh National Pedagogical, Almaty, Kazakhstan
Seidaliyeva.Gulnara@kaznaru.edu.kz

Abstract—The aim of this study is to determine the adoption of distance education and mobile technology by university students. Quantitative research method was used in the study. The research was conducted in the fall semester of 2021-2022. Volunteer 412 university students continuing their education in Kazakhstan participated in the research. In the research, 3-week online education mobile technology training was given to university students. "Mobile Technology in Education" measurement tool developed by the researchers and compiled by experts in the field was used in the research. The measurement tool was delivered and collected by university students via online method. The analysis of the data was made by using the SPSS program, frequency analysis, t-test, and the results were added to the research in the presence of tables. According to the results obtained from the research, it was concluded that there was a significant difference between the post-test mobile technology status of university students and that their mobile technology status was high.

Keywords—mobile technology, distance education, university students, quantitative research

1 Introduction

Today, mobile technology finds a lot of use, from communication to education and all. The importance of digitalization is increasing, especially because it provides advantages in many aspects such as speed, cost and time [1]. It is known that one of the usage areas in question is the field of education, it can be said that it has been the focus of attention in recent years because it provides the integration of education components by eliminating the space and time limit with mobile technology [2]. It is seen that with the improvement of mobile technology and internet, equivalent technologies and methods have emerged. It is seen that the use of mobile technology has increased intensively due to COVID-19 with distance education. In addition, it is estimated that the use of this and similar technology will continue, as there is still

uncertainty around the world about how long this time period will continue. The most important stakeholders of mobile technology application are actors taking part in educational activities [3]. With this method, it is an important issue whether the mobile application serves the determined purpose, and in which subjects it provides services. It is thought that the adoption level of the mobile application users and their expectations from the application are an important issue that should be emphasized [4]. Distance education, which serves this purpose, and whether the variables of ease of use of mobile technology and perceived pleasure have an effect on perceived usefulness and perceived intention are tested with the model created within the scope of the research [5]. While contributing to the development of mobile digital applications similar to distance education is among other purposes, it is thought that it will contribute to the literature in terms of perceived ease of use, functionality and perceived intention variables, determining the level of adoption of digital applications, and expanding the usage areas for the pandemic process and after [6].

It is essential to encounter various meanings related to distance education and e-learning in research articles. It is seen that distance education is defined as a type of education that students and teachers in different environments perform with communication technologies and postal services [7]. It is defined as "any learning, teaching or educational activity enabled by the use of well-known mobile technologies, especially internet technology-based applications" [8]. Distance education is a broad concept that includes applications and processes such as technology-based education, mobile-based education, online classroom models and digital collaboration. It is seen that distance education enables students to take responsibility for their own learning [9]. It is expected that students will be able to create equal opportunities in education and enable them to benefit from lifelong education, and course materials can be easily updated, when necessary, with mobile technology [10]. Students' perspectives and the integration of these technologies into the process are of great importance in order to include these advantages brought by distance education into the teaching process [11]. It is known that determining the key factors affecting the perspectives of learners on distance education and mobile technology together will create significant advantages for both universities and businesses [12].

1.1 Related studies

In their study, [13] aimed to evaluate the factors affecting university students' adoption of mobile technologies for mobile learning (m-learning) in their learning processes, and according to this, in their research, they found that students' adoption behaviours towards mobile technology adoption and students' benefit and perceived ease of use. It has been found that it has a direct positive effect on the structures.

In his planned studies, [14] aimed to investigate the factors that predict online students to use the mobile learning management system (m-LMS), and as a result, it is valid for low-income students with digital literacy skills and limited access and for many students, While institutions primarily teach in online modalities during the COVID-19 pandemic, it is seen that mobile technology is the only way for them to continue taking courses.

In the research conducted by [15], they aimed to investigate the perceptions of students about the Madrasa platform and also to determine the important factors that may affect the adoption of the Madrasa platform. and that it can help facilitate and encourage the use of the Medrasati platform among students.

As seen in the related research section, when distance education technologies and mobile applications are combined with the course, it is seen that they benefit the field and both the trainers and the people who take the course. Research will continue on distance education and mobile learning.

1.2 Purpose of the study

The aim of this study is to determine university students' adoption of distance education and mobile technology. In order to achieve the aim of the research, answers to the following questions were sought:

1. What is the distance education performance status of the participant groups participating in the research?
2. What is the general level of acceptance of mobile technology by the participant groups participating in the research?
3. Is there a difference between the levels of acceptance of distance education by the participant groups participating in the research?
4. Is there a difference between the distance education and performance levels of the participant groups participating in the research?
5. Is there a difference between the levels of following the mobile technology and distance education of the participant groups participating in the research?

2 Method

Research method the research method used was in the hands in which the partial is being monitored when given information about if the numerical values in the type and source of the method section in research, data collection instruments and the information given is compiled according to the study, are arranged.

2.1 Research model

The model used in the research is seen as a quantitative research model, and it is known that with this model, the ideas and behaviors of the participant audience will be reached and benefited from. When the quantitative research model is considered, when we collect data about this model, it is seen that this method reveals the answers of numerical and statistical findings. In addition, since this method is based on numbers, the sample representing the event or phenomenon should be determined completely and the right questions should be asked [16]. In addition, the aim of the study was continued by patterning according to the determination of university students to adopt distance education and mobile technology.

2.2 Working group/participants

The research was carried out in the fall academic year of 2021-2022. It is seen that the data of the research consists of 412 participant groups randomly studying at the university in Kazakhstan. All of these students take their courses by linking distance education and mobile technologies.

Gender. In this section, the gender status of the participants participating in the research was examined and detailed information is given in Table 1.

Table 1. Distribution of University Students by Gender

Gender	Male		Female	
	F	***%***	***F***	***%***
Variable	207	50.24	205	49.76

As seen in Table 1, it is seen that the gender data of the participant groups participating in the research are included, in this context, it is stated that 50.24% (207 people) are male participants, while 49.76% (205 people) are female participants. In the gender section, the findings reflect the actual gender distribution.

Class. In this section, the class variable conditions of the population participating in the research were examined and detailed information is given in Table 2.

Table 2. Distribution of Students Participating in the Study by Class

Class	3.Class		4.Class	
	F	***%***	***F***	***%***
Variable	170	41.26	242	58.74

As can be seen on the Table 2 given in the research, it is seen that the class distributions of the study group participant groups are given and examined. It appears to be in the 4th grade range. In the Class division, the findings reflect the actual Division distribution.

Does encountering distance education in the classroom environment affect performance positively? An answer was sought to the question of whether seeing the participant groups included in the study in a classroom environment with distance education affects your performance, and their distribution is given in Table 3.

Table 3. Distance Education technologies performance status

Related Question	Yes		No	
	F	***%***	***F***	***%***
Variable	408	99.03	4	0.97

When Table 3 is examined, 99.03% (408 people) of the participants included in the study answered yes, while 0.97% (4 people) answered no, it can be said from this table that a positive result will be obtained if the participants of the study are processed in the classroom environment with distance education.

2.3 Data collection tools

In the data collection tool section, it is seen that first of all, information will be given about which type of data collection tool will be used in the study. Data collection instruments in research of mobile technology distance education and the views of the participants to get the dimensions to increase, it is known that in the course of preparing this technology also examined by experts from research and the data collection tool was prepared to be correct by subtracting sallastirilm unsuitable materials. The personal information form developed by the researchers, which is called the ”Mobile Technology in Education" data collection tool and applied to the groups of participants participating in the study, was used. The scope validity of the developed measurement tool was examined by experts with the title of 4 professors who work on distance education systems and mobile technology platforms, and unnecessary items were removed from the measurement tool and rearrangements were made.

1. Personal Information Form (Demographic Data): In the personal information form, information such as gender, class, mobile technology performance effects are included.
2. Mobile Technology in Education Data Collection Tool: A 5-point likert-type questionnaire was prepared in order to get information about the opinions of the participant groups participating in the study about distance education and mobile technology situations and to adapt to this environment. 24 items of the measurement tool consisting of a total of 28 items were used and 4 items were removed from the measurement tool thanks to the expert opinion. The opinions of the participants participating in the research were consulted from two factorial dimensions, such as the situations of the participant groups participating in the study, such as “Distance Education” and “Mobile Technology”. The Cronbach Alpha reliability coefficient of the measurement tool as a whole was calculated as 0.81. Measurement tool; “strongly disagree” (1), “disagree” (2), “I'm undecided” (3), “agree” (4) and “strongly agree” (5) in the form of rated. The measurement tool was collected from the groups of participants who participated in the study in the form of an online environment with the MS teams questionnaire.

2.4 Application

Live courses have been prepared for 412 university students who continue their studies in Kazakhstan in the form of interactive online education consisting of a total of 7 sections. during the 3-week training, interactive distance education and online training courses were given to the participant groups included in the research on the occurrence and determination of mobile technology situations, these trainings; distance education, how to use the combination of mobile technology and professional activity, how to reconcile it with time, how to accept the use of distance education, what is its adaptation, etc., after 3 weeks of training, all of the data collection tools were applied to the participant groups participating in the study and the data were given in the findings section in tables. Education by many institutions and organizations meet over each section so it will be limited to 60 people, preferred Ms teams is

set to be distributed over weeks, and a 50-minute time frame that has been processed in each course participant groups in the environment of online education each week to be included in a case study was applied. The information received from the data collection tool applied to the participant groups was transferred to the analysis program in the form of numerical values.

2.5 Analysis of the data

The data collected together with the online survey were analyzed using the SPSS application. The percentage, frequency and descriptive, T-test (independent–samples t-test), Kruskal Wallis H-Test, one-way ANOVA methods of the analysis results were given. The data related to numerical developments were tabulated and Deciphered, and whether there is a significant difference between the independent variables was tested at the level of α =0.81. In addition, while analyzing the data, help was taken from the information on Table 4.

Table 4. Limitations

Weight	Limits	Choice
1	1.00 - 1.80	I strongly disagree
2	1.81 - 2.60	I do not agree
3	2.61 - 3.40	I'm undecided
4	3.41 - 4.20	I agree
5	4.21 - 5.00	Absolutely I agree

3 Findings

In this section, the findings related to the acceptance and determination of the participant groups participating in the research based on the dimensions of distance education and mobile technology and the findings related to the objectives are given

3.1 Descriptive statistical findings of the mobile technology acceptance levels of the participants participating in the research

Descriptive statistics regarding the determination of the mobile technology acceptance levels of the participants participating in the research are given in Table 5.

Table 5. Descriptive Statistical Findings of the Mobile Technology Acceptance Levels of the Participants Participating in the Research

Dimension	Cours Name	N	*M*	S
Accepting with Mobile Technology	Online and Distance Education events	412	4.42	.428
Using Mobile Technologies	Online and Distance Education events	412	4.39	.417
Mobile Technologies Evaluation	Online and Distance Education events	412	4.37	.434

As can be seen in Table 5, it is seen that the groups of participants participating in the study have an average of M= 4.42 according to their mobile technology acceptance status regarding the determination of their level of acceptance of mobile technologies. In addition, it is seen that the average of using mobile technologies is M=4.39, and finally, the assessment scores of mobile technologies are M=4.37. In the light of these findings, it can be said that the mobile technologies of the participant groups participating in the study and their acceptance and acceptance of this technology are high, and the dimensions of registration, technical support and evaluation are in place.

3.2 T-Test analysis findings of the participants participating in the study according to the gender variable of the acceptance levels of distance education

Of the participants surveyed levels of acceptance and use of distance education is a significant difference between the Sexes was applied in order to determine whether the independent - samples t-test on data findings are given.

As seen in Table 6, according to the gender variable, the arithmetic mean and standard deviation scores of male students to accept the system distance education M=4.42 female students with arithmetic average and standard deviation scores of records in the system distance education M=4.39, respectively. From the findings obtained, it can be said Decisively that there is no difference between male and female students. Also finding other when examined, the male arithmetic average and standard deviation scores of students of distance education adoption and use of M=4.38, but a female arithmetic average and standard deviation scores of students of distance education adoption and use of M=4.36, respectively. From the findings obtained, it can be said that there is no difference between male and female students according to the technical support department of the distance education system. Dec. Finally, Table 6 also arithmetic average and standard deviation of male students of distance education evaluation scores of the property M=arithmetic mean and standard deviation scores of female students with the assessment system 4.39 M=4.37, respectively. From the findings obtained, it can be said that there is no difference between male and female students according to the Decency of accepting and using distance education.

Table 6. T-Test Analysis Findings of the Participants' Acceptance Levels of Distance Education According to Gender Variable

Dimension	Gender	N	*M*	SS	Sd	t	p		Explanation
Acceptance to the Distance Education System	Male	207	4.42	.541	412	.218	.521		p>0.05 difference meaningless
	Female	205	4.39	.568					
Using and Implementing Distance Education	Male	207	4.38	.524	412	.232	.632		p>0.05 difference meaningless
	Female	205	4.36	.534					
Distance Education Evaluation	Male	207	4.39	.588	412	.288	.428		p>0.05 difference meaningless
	Female	205	4.37	.610					

3.3 T-Test Analysis findings among the distance education and performance levels of the participant groups participating in the decision

In this section, the Deficiency data of the independent-samples t-test findings applied to determine whether there is a difference between the distance education and performance levels of the participant groups participating in the research according to the distance education variable of university students are given.

As seen in Table 7, the variable distance education according to the arithmetic average and standard deviation scores of students who answered yes M= 4.38 distance education with arithmetic average and standard deviation scores of students who reported not according to the variable M=2.62, respectively. From the findings obtained, it can be Deciphered that there is a significant difference between students according to the distance education variable. Also as shown in Table 7, the variable performance according to the performance of distance education students who answered yes, the arithmetic average and standard deviation scores of the value of M= 4.41 distance education with arithmetic average and standard deviation scores of students who reported no performance according to the variable M= 2.37, respectively. From the findings obtained, it can be said based on Table 7 that there is a significant difference when both dimensions are considered.

Table 7. Results of T-Test Analysis of mobile technologies and performance levels participating in the research

Dimension	Criterion	N	*M*	SS	Sd	T	p	Explanation
Distance Education	Yes	408	4.38	.442	412	.-5.52	.000	P<0.05 difference significant
	No	4	2.62	.228				
Distance Education Performance	Yes	408	4.41	.521	412	.-8.41	.000	P<0.05 difference significant
	No	4	2.37	.233				

3.4 One way ANOVA results of the levels of mobile technology and distance education follow-up of the participant groups participating in the study

In order to determine whether there is a difference between the levels of following mobile technology and distance education technologies of the participant groups participating in the study, data on the values of One Way ANOVA results were given.

As shown in Table 8, the level of tracking groups of participants surveyed mobile technology "mobile technology" showed a statistically significant difference between. According to the findings obtained, it can be said that the groups of participants who participated in the study were more effective in the mobile technology tracking dimension according to their performance. Finally, as shown in Table 8, the surveyed groups of participants “Distance Education Technologies” showed a statistically significant difference between opinions of Don't follow. According to the findings obtained, it can be said that the size of the follow-up of distance education technologies of the participant groups participating in the research is effective.

Table 8. One Way ANOVA Results of the Mobile Device and Media Technology Tracking Levels of the Participant Groups Participating in the Study

Dimension	Source of Variance	Sum of Squares	Sd	Average of Squares	F	p	Description
Mobile technology	Intergroup	8.78	4	2.30	8.192	.000	p<0.05 difference significant
	Ingroups	38.689	408	.253			
	Total	47.477	412				
Distance Education Technologies	Intergroup	17.109	4	5.06	17.576	.000	p<0.05 difference significant
	Ingroups	33.367	408	.215			
		50.476	412				

4 Discussion

In the work they have done in the year as we bought the theoretical framework of technology acceptance Model and students, [17] sought to explore the factors that affect their intention to use an online education platform, business online course in research design and as a result, perceived system quality and perceived external variables such as enjoyment and education that is detected with the help of an extra variable (Perceived Interactivity), defined as predictors of intention to use the platform they achieved effective education of students. When this value is combined with the results of the research, it is seen that the results have been reached that the groups of participants who participated in the research accept and use distance education technologies while using them in the course. In this context, it can be said in the discussion section of the research that this method used in the research benefits both the participants and the next generation.

It has been widely adopted to address the educational chaos created by the Covid-19 pandemic in the work of [18]. Reports on its limitations and difficulties are published daily in the global media. However, explanations for the experiences of teachers and students regarding this sudden change in the pedagogical modality are conspicuously absent in the current literature. This article in the context of higher education in Bangladesh and Nepal during the epidemic, teachers and students was undertaken to investigate their experiences of online learning and tailored to the local context and the action potentials of digital artifacts as a result of their using them in the best possible way to facilitate communication and improve student learning, they showed that they achieved. In this context, when this value is combined with the results of the research, it is seen that the dimensions of using mobile technology are high in the study and it is also concluded that they use this technology very well with distance education technologies. Even if it is seen that both values in the research are high, it can be said that more beautiful studies about the concept of distance education should be included in the studies.

In the year to continue their journey in facilitating students ' learning conditions and the work they have done for using this interactive resources interactive conferencing software, [19] aims to investigate the perceptions and attitudes towards and perceptions as a result facilitator and also emphasized the importance of providing ap-

propriate conditions to develop a COVID-19 digital transformation in education is inevitably the speed reaches values it is seen that these results reflect the most recent developments. In this context, when this value is combined with the results of the research, it is seen that the values that benefit the participant groups by using distance education and mobile technology dimensions in an interactive way have been reached in the study.

If it is to be said that all the work in the discussion section has a meaning integrity, it can be said that while distance education and technology benefit people and people, a different dimension will always develop in the field article. While each value in the research is ahead of the previous one, it is among the expectations to be made again in the future periods within this research.

5 Conclusion

If the result section of the research is to be discussed, it is seen that the number of people who were included and formed from the participant groups came first. If the results of these people are considered by creating a semantic integrity, it is seen that 412 people voluntarily participated in the research. If another value of the research is to be discussed, does the encounter in the classroom environment with distance education positively affect the performance of the groups of participants included in the study from their distribution, it is seen that most people answer yes and reach the value that there is a positive result if it is processed in the classroom environment with distance education. Also participating in the survey research of the participating groups alinack to get another value if the level of acceptance of mobile technologies mobile technology has achieved high results for the determination of acceptance durumlarinnin also adopt mobile technology to accept their status and high levels of registration, technical support and evaluation, it is seen that reached higher values of the dimension.

When another value of the research is considered, it is seen that there is no difference between the arithmetic mean and standard deviation scores of male students for admission to the distance education system and the scores of female students according to the gender variable Decisively. Also, the other finding is examined, the remote training system according to the Technical Support section, reached the conclusion that there was not any significant difference between male and female students, it is seen that distance education is also the ability to accept that there was not any significant difference between male and female students according to the conclusion reached is that it is seen. Another result of the research is that it has been Decisively concluded that there is a significant difference between students according to the distance education variable. From the findings obtained in this context, it can be seen that there is a significant difference when both dimensions are considered. Finally, the level of tracking groups of participants surveyed mobile technology "mobile technology", it is seen that the conclusion is reached that there is a statistically significant difference between. According to the obtained results, the surveyed groups of participants according to the performance of the track size of mobile technology is more effective

and also the "distance education technologies" that there is a statistically significant difference between the opinions of Don't follow, it is seen that conclusion is reached. According to the findings obtained, it can be said that it has been concluded that the follow-up dimension of distance education technologies of the participant groups participating in the research is effective.

According to the results obtained from the research, it has been concluded that there is a significant difference between the last test mobile technology Decencies of university students and that their mobile technology statuses are high.

6 References

[1] Istiana, R., Rahmayanti, H. ., & Sumargo, B. . (2021). Marine environmental education learning system recommendation model based on student needs analysis in Indonesian coastal areas. *Cypriot Journal of Educational Sciences*, *16*(5), 2236–2247. https://doi.org/10.18844/cjes.v16i5.6305

[2] Kay, R. (2020). Analyzing the use of mathematics apps in elementary school classrooms. *Contemporary Educational Researches Journal*, *10*(2), 68–78. https://doi.org/10.18844/cerj.v10i2.4732

[3] Gurban, S., Zhiembaev, A., & Zeybel, V. (2022). Popularization of physical activity in rural schools of Kazakhstan's Aktobe region. *New Trends and Issues Proceedings on Humanities and Social Sciences*, *9*(1), 31–42. https://doi.org/10.18844/prosoc.v9i1.7093

[4] Ferdosipour, A., & Musavi, H. (2022). Determining the relationship between quality of work life of teachers and quality of school life of high school students. *Global Journal of Guidance and Counseling in Schools: Current Perspectives*, *12*(1), 01–11. https://doi.org/10.18844/gjgc.v12i1.5304

[5] Schellini, M., & Rahimi , A. (2022). Color application in vernacular architecture in Southern India: An Intangible cultural phenomenon?. *Global Journal of Design Art and Education*, *12*(1), 19–33. https://doi.org/10.18844/gjae.v12i1.6837

[6] Odabasi, M., Uzunboylu, H., Popova, O., Kosarenko, N. & Ishmuradova, I. (2019). Science Education and Mobile Learning: A Content Analysis Review of the Web of Science Database. *International Journal of Emerging Technologies in Learning (iJET), 14*(22), 4-18. Kassel, Germany: International Journal of Emerging Technology in Learning. https://doi.org/10.3991/ijet.v14i22.11744

[7] Caliskan, S., Shukshina, L. V. ., Niyazova , A. Y. ., Kulakova , N. N. ., Ishmuradova, A. M. ., & Kunitsyna , M. L. . (2022). Investigation of Mechanical Engineering Academicians' Use of Distance Education Technologies. *International Journal of Engineering Pedagogy (iJEP)*, *12*(2), pp. 115–128. https://doi.org/10.3991/ijep.v12i2.29331

[8] Yimer, S., & Gizachew, B. (2022). The development of a Web-Based application security testing framework in Addis Ababa, Ethiopia. *Global Journal of Computer Sciences: Theory and Research*, *12*(1), 12–22. https://doi.org/10.18844/gjcs.v12i1.6762

[9] Ozaeta, L. ., Perez, I. ., & Rekalde, I. . (2022). Interactive storytelling for the retelling of autobiographical memory in children: A social robotics approach. *Global Journal of Information Technology: Emerging Technologies*, *12*(1),43–50. https://doi.org/10.18844/gjit.v12i1.7111

[10] Xue, E., Li, J., & Xu, L. (2022). Online education action for defeating COVID-19 in China: An analysis of the system, mechanism and mode. *Educational Philosophy and Theory*, *54*(6), 799-811. https://doi.org/10.1080/00131857.2020.1821188

[11] Aruleba, K., Jere, N., & Matarirano, O. (2022). Technology Adoption Readiness in Disadvantaged Universities during COVID-19 Pandemic in South Africa. *International Journal of Higher Education*, *11*(2). https://doi.org/10.5430/ijhe.v11n2p172

[12] Azizan, S., Lee, A., Crosling, G., Atherton, G., Arulanandam, B., Lee, C. & Abdul Rahim, R. (2022). Online Learning and COVID-19 in Higher Education: The Value of IT Models in Assessing Students' Satisfaction. *International Journal of Emerging Technologies in Learning (iJET), 17*(3), 245-278. Kassel, Germany: International Journal of Emerging Technology in Learning. https://doi.org/10.3991/ijet.v17i03.24871

[13] Zaidi, S.F.H., Osmanaj, V., Ali, O. and Zaidi, S.A.H. (2021), "Adoption of mobile technology for mobile learning by university students during COVID-19", *International Journal of Information and Learning Technology,* Vol. 38 No. 4, pp. 329-343. https://doi.org/10.1108/IJILT-02-2021-0033

[14] Antee, A. (2021). Student perceptions and mobile technology adoption: implications for lower-income students shifting to digital. *Educational Technology Research and Development*, *69*(1), 191-194. https://doi.org/10.1007/s11423-020-09855-5

[15] Almaiah, M. A., Hajjej, F., Lutfi, A., Al-Khasawneh, A., Shehab, R., Al-Otaibi, S., & Alrawad, M. (2022). Explaining the Factors Affecting Students' Attitudes to Using Online Learning (Madrasati Platform) during COVID-19. *Electronics*, *11*(7), 973. https://doi.org/10.3390/electronics11070973

[16] Mamadaliyev, S. ., Akbota, A. ., Kuatbekova, R., Nurlybekova, A., & Makulova, A. (2022). The use of project-based learning technology in the professional training of special teachers. *World Journal on Educational Technology: Current Issues*, *14*(4), 1094–1105. https://doi.org/10.18844/wjet.v14i4.7674

[17] Zhou, L., Xue, S., & Li, R. (2022). Extending the Technology Acceptance Model to explore students' intention to use an online education platform at a University in China. *SAGE Open*, *12*(1), 21582440221085259. https://doi.org/10.1177/21582440221085259

[18] Shrestha, S., Haque, S., Dawadi, S., & Giri, R. A. (2022). Preparations for and practices of online education during the Covid-19 pandemic: A study of Bangladesh and Nepal. *Education and information technologies*, *27*(1), 243-265. https://doi.org/10.1007/s10639-021-10659-0

[19] Camilleri, M. A., & Camilleri, A. C. (2022). Remote learning via video conferencing technologies: Implications for research and practice. *Technology in society*, *68*, 101881. https://doi.org/10.1016/j.techsoc.2022.101881

[20] Kasimatis, K., Bekiari, E. & Delikari, V. (2022). Project-based learning's effect on the development of students' skills in the first grade of Senior High School. *International Journal of Current Innovations in Interdisciplinary Scientific Studies. 6(1), 45 -68*. https://un-pub.eu/ojs/index.php/IJ-CISS/article/view/6903

7 Authors

Seidaliyeva Gulnara Orazbekovna is a Candidate of Agricultural Sciences, Professor, Kazakh National Agrarian Research University, Almaty, 8 Abai avenue, Kazakhstan (email: Seidaliyeva.Gulnara@kaznaru.edu.kz, https://orcid.org/0000-0003-1995-9353).

Seidaliyeva Gaukhar Orazbekovna is a PhD, Associate Professor, University of International Business,vAlmaty, Abai avenue 8a, Kazakhstan (email: seidaliyeva.g @uib.kz, https://orcid.org/0000-0003-4184-6865).

Darkhan Ydyrysbayev, Doctoral student of the specialty "Informatics" of the M. Auezov South Kazakhstan University, 160000 Republic of Kazakhstan, Shymkent, Tauke-Khan Ave., №5. (email: Darkhan.Ydyrysbaev@auezov.edu.kz, https://orcid.org/0000-0002-3179-585X).

Gulnar Zhakypbekova, a Candidate (Ph.D) of Pedagogical Sciences, Associate Professor (Department of Computer Science), M. Auezov South Kazakhstan University 160000 Republic of Kazakhstan, Shymkent, Tauke-Khan Ave., №5 (email: Gulnar.Zhakypbekova@auezov.edu.kz, https://orcid.org/0000-0003-4459-689X).

Bakhyt Sydykhov, Doctor of Pedagogical Sciences, Professor of the Department of "Informatics and Informatization of Education" , Abai Kazakh National Pedagogical University Address: 050010, Alma-Ata, Dostyk Ave., 13 (email: b.sydykhov@abaiuniversity.edu.kz, https://orcid.org/0000-0003-3404-2914).

Article submitted 2022-07-18. Resubmitted 2022-09-10. Final acceptance 2022-10-01. Final version published as submitted by the authors.

Internet of Things and Its Applications to Smart Campus: A Systematic Literature Review

https://doi.org/10.3991/ijim.v16i23.36215

Nadire Cavus[1,2(✉)], Seipati Elizabeth Mrwebi[3], Imran Ibrahim[1], Temiloluwa Modupeola[1], Albert Y. Reeves[1]
[1] Department of Computer Information Systems, Near East University, Nicosia, Cyprus
[2] Computer Information Systems Research and Technology Centre, Near East University, Nicosia, Cyprus
[3] Department of Innovation and Knowledge Management, Near East University, Nicosia, Cyprus
nadire.cavus@neu.edu.tr

Abstract—A smart campus is an emerging trend that will revolutionize the education system by enabling universities to improve services, and processes as well as achieve sustainability goals. With the proliferation of advanced technologies, a smart campus has emerged as an important concept that integrates technology into higher education. A smart campus takes advantage of IoT technologies to facilitate teaching and research activities. The purpose of this study is to identify the IoT technologies that are required in the development of a smart campus. This study uses a Systematic Literature Review (SLR) methodology and PRISMA processes to analyze high-quality articles on the IoT-based smart campuses from the last five years (2017-2022) as extracted from three databases like Scopus, ScienceDirect, and IEEE. The findings of the study reveal that the implementation of an IoT-based smart campus offers many advantages and benefits but also presents challenges requiring further exploration. Because of the chosen research approach, the research results may lack generalizability. Therefore, researchers are encouraged to test the proposed propositions further. The paper explores the many benefits and advantages that are brought by the implementation of IoT-based smart campuses. It also identifies key challenges that are presented by such implementations. Researchers, policymakers, teachers, and students can benefit from this study by gaining insights into the IoT-based smart campus.

Keywords—smart campus, smart university, Internet of Things, IoT applications, big data

1 Introduction

With the proliferation of advanced technologies, a smart campus has emerged as an important concept that integrates technology into higher education. The arrival of the Internet of Things (IoT) has revolutionized the education industry [1] and increased competition among universities to improve quality in an attempt to become excellent

universities [2]. Moreover, the quality of the university is an important factor that students consider when choosing a university to pursue their education further. The availability of an array of devices and the reach of the Internet has made the IoT a perfect solution for building a smart campus as well as applications previously requiring human intervention. IoT is about collecting accurate raw data, analyzing it, and then converting it into information of value [2]. A smart campus takes advantage of IoT technologies to improve the performance of processes and activities [3]. In alignment, Liang and Chen [4] contend that a smart campus supports teaching, scientific exploration, and services through the use of IoT, cloud computing, and geographic information systems.

On the other hand, another new technology, artificial intelligence, has also brought a conceptual shift to the concept of a smart campus. It has transformed the education and teaching methods of the university to become more diverse and advanced [5] and identified seven areas of a smart campus including governance, environment, buildings, people, mobility, living, and economy [6]. Furthermore, a smart campus serves as a major gateway to information for university students. It strives to improve its technological infrastructure to provide quality education and improve user experience [7] by providing the university community with sophisticated and personalized information. Through this system, students gain access to an interactive learning platform with global content and can adapt their learning strategies according to the gathered data [8].

Through a smart campus, educational institutions can improve their sustainability performance and enhance research experiences through easy access to data and campus facilities [9]. Additionally, they can improve the operation and management of university buildings, including energy conservation and environmental sustainability [10]. Furthermore, the Covid-19 outbreak has placed tremendous pressure on educational institutions to take advantage of advanced technologies to revolutionize their teaching methods. The Internet of Things connects people, devices, processes, and data, enabling stakeholders in education to turn the data collected by sensors and portable devices into useful information [8]. Although technological advancements have enabled education to advance rapidly, the implementation of smart technologies is not without challenges that still require further exploration.

It is therefore within the objective of this study to determine which IoT applications are required to achieve a smart campus. Through a systematic literature review, this study aims to identify various applications providing answers to the formulated research questions:

- RQ1: What is the distribution of publications over the years?
- RQ2: What is the publication's geographic distribution?
- RQ3: Which research methodologies have been used?
- RQ4: Which technologies are required for a smart campus?
- RQ5: What are the advantages/benefits of deploying IoT in a smart campus?
- RQ6: What are the challenges experienced in deploying IoT in a smart campus?

2 The theoretical framework

2.1 Internet of Things

Things Internet of (IoT) is an innovation arising from current technological advancements. The term refers to a system of devices or things that interact with each other to collect, exchange and use data from the environment and the users [2] and integrates various technologies to deliver smart services to the users [10]. In simpler terms, IoT is a way of connecting devices and objects through a private network (intranet) or a public network (internet), so they are visible to each other and can communicate with each other [11]. Zhou et al. [12] stated that it has three characteristics: Comprehensive perception, reliable data transmission, and intelligent processing. IoT is the aggregation of connected devices, data analytics, and physical objects [13] and brought along desirable technological advances of Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), and 3D immersive learning [14]. There is a greater opportunity for these tools to revolutionize the teaching and learning processes, as they would allow students to engage in immersive learning that is a hugely effective elevating learning experience.

The use of IoT applications is essential in managing things efficiently and economically. It can support the process of improving campus quality of life by implementing a smart campus system [2]. As IoT-enabled services generate large amounts of data, they are useful for a multitude of applications and optimizing critical infrastructure as well as providing new insights and modern advancements [15]. The majority of this data will be sensitive, demanding unobtrusive treatment that will not compromise the freedom and privacy of the users. IoT can support key functions of university education, such as teaching, learning, research, innovation, and support functions. As a result, faculty and administration processes are integrated seamlessly and campus infrastructure is managed more efficiently, effectively, cost-effectively, and at a high standard of quality. Additionally, IoT supports the interactive learning of students by inspiring their innovation everywhere on campus [16].

2.2 Smart campus

A literature search has not provided a universal definition of a smart campus. However, many authors have provided various definitions in their studies. According to Anagnostopoulos et al. [15], smart campuses are popular solutions among universities willing to experiment intuitively with unknown situations and receptive to change management. This aligns with a definition presented by Zaballos et al. [17] that a smart campus facilitates efficiency and allows for miniature experimentation by leveraging technology. A smart campus is a small-scale version of a smart city with advanced capabilities that facilitate creativity, social interaction, and intellectual exploration [18] [19]. The similarities between a smart city and a smart campus anchor on many aspects: They cover large urban areas with many different buildings (administrative buildings, residential halls, research laboratories, lecture halls, bars, and cafés) and are inhibited by a variety of people including university staff and students [20]. Additionally, Chagnon-Lessard et al. [6] shared an organizational structure that encompasses seven

smart areas such as "smart building, smart economy, smart environment, smart governance, smart living, smart mobility, and smart people". This structure can expand to include information and communication infrastructure that enables the smartness of all these smart areas.

The construction of a smart campus uses IoT technologies to combine learning activities with supporting devices to achieve intelligent management of university services [21]. A smart campus is a vital platform for students to access all types of information. It strives to improve its technological infrastructure to provide quality education and improve the user experience [7] by providing the university community with sophisticated and personalized information. Additionally, it integrates learning and living environments, bringing many benefits to campus users [21]. Nevertheless, the IoT-powered smart campus is still in its infancy and has a long way to go before fulfilling all its potential. Most IoT implementations used the same technologies to achieve a smart campus [11] and these are Artificial Intelligence (AI), Big Data, Cloud Computing, and many other newer technologies [22-24] [7] [11] [3]. The application of these technologies is essential for building capacity at the university campus to improve processes and achieve sustainability. Cloud computing enables intelligent and secure management of information in a private cloud created within the university's existing infrastructure [25]. Big data analytics facilitates better data processing, analysis, and information sharing to enhance decision-making [9]. The processing of big data through artificial intelligence can contribute greatly to creating innovative learning solutions and delivering sophisticated solutions [18].

3 Methodology

3.1 Research design

Following the guidelines proposed by Kitchenham and Charters [26], a Systematic Literature Review (SLR) was carried out. This guideline suggests a strict predefined protocol that guides a researcher throughout the research process. This meticulous process identifies researchers' biases, flaws, and gaps in knowledge, as well as indicates the direction in which further research may be of benefit. Kitchenham and Charters [26] defined a systematic literature review as a means by which researchers "identify, evaluate and synthesize all available research relevant to a particular research question, topic area, or phenomenon of interest" (p. 3). Lamé [27] provided a summary of the steps involved in the development of a systematic literature review: (1) Structuring a clear question for review, (2) Definition of the inclusion and exclusion parameters, (3) Identification of relevant studies, (4) Selection of the studies to be included or excluded from the study, (5) Quality assessment of the studies, (6) Extraction of relevant data (7) Summarizing and synthesizing the evidence and (8) Interpretation of the results.

3.2 Search strategy

As shown in Figure 1, a systematic literature search was conducted in three databases: Scopus, ScienceDirect, and IEEE following the PRISMA flow. In this search, only English-language papers published in the last five years, between January 2017 and January 2022 were considered. The keywords and search operators used were ("Internet of Things" OR "IoT") AND ("smart campus" OR "smart university").

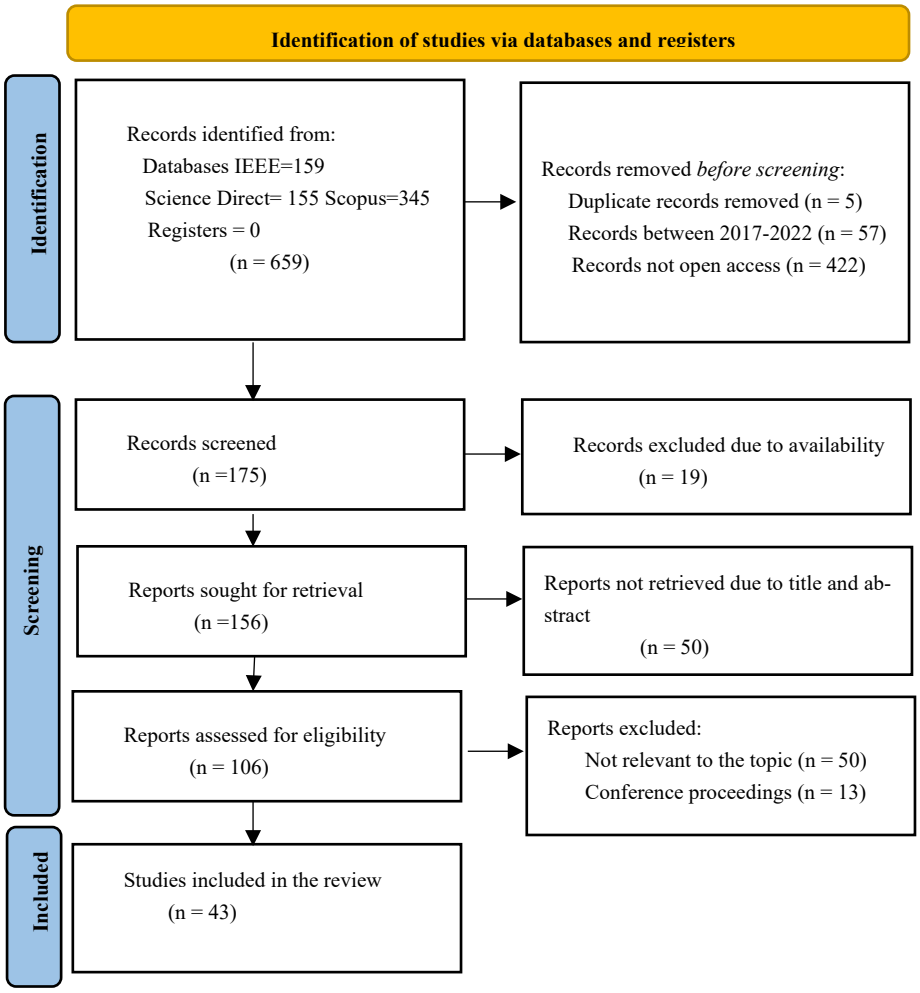


Fig. 1. PRISMA flow diagram of the study

3.3 Inclusion and exclusion criteria

To obtain relevant studies that fall within the scope of this study, the inclusion and exclusion criteria were considered during the study selection process [26]. To ensure a

rigorous selection process, inclusion criteria were clearly outlined; papers were to be published in English and fully accessible in the named databases, as indicated in Table 1. Published works that failed to meet these conditions were excluded.

Table 1. Inclusion and exclusion criteria of the study

No.	Inclusion Criterion
IC1	The English language articles.
IC2	Published articles between 2017 and 2022.
IC3	Articles focused on IoT and smart campuses.
IC4	Articles exploring the applications of IoT to a smart campus.
IC5	Articles are available in full text.
No.	**Exclusion Criterion**
EC1	Books, book reviews, editorial materials, conference proceedings, and theses.
EC2	Duplicated studies.
EC3	Full text of the article is not available for download.
EC4	Articles that are not relevant to the stated research question.
EC5	Articles lacking adequate detail to answer the research questions.

3.4 Selection criteria

The search on the databases yielded 659 records: ScienceDirect = 155; IEEE = 159; and Scopus = 345. Before the screening, the records were checked to be certain no duplicate records were obtained from the databases. Five duplicates were detected and removed. The research was limited to open access records, 422 records were eliminated. Records not published within 2017-2022 were also eliminated. A further 19 records were eliminated as the full text of the records was not available for retrieval. In implementing the inclusion and exclusion criteria, 156 articles were generated, of which 50 were eliminated, as they were unrelated to the topic. A further 63 articles were removed for not exactly fitting inclusion criteria or were outside the scope of the study. The remaining 43 articles were retained for further review and analysis in the results section. Table 1 itemizes the key items of the inclusion and exclusion criteria used in the study. It must be noted that even though a rigorous approach has been followed for selecting the studies that were reviewed, it is unreasonable to claim that all smart campus facets were fully covered. Furthermore, it is also possible that a search in other databases could have yielded additional studies in these categories (see Figure 1).

3.5 Data analysis

Using the retrieved articles that meet all the inclusion criteria, data is categorized as follows:1) Title; 2) Year of publication; 3) Objectives; 4) Geography; 5) Methodology; 6) Key findings; 7) Recommendations; 8) Technologies; 9) Challenges; 10) Benefits; 11) Advantages; 12) Citation.

3.6 Data analysis

To standardize the data extraction process, the data extraction stage [28] considered 43 studies and complied with a list of elements established specifically for this study.

Table 2. Data extraction from the selected studies

Data item	Description
Reference	Name(s) of the author(s) and year of publication
Geography	The country in which the research was undertaken
Study objectives	The main aims of the study
Methodology	The study approach
Findings	Key findings of the study
Technologies	Which are the IoT technologies implemented
IoT applications	Which are the IoT applications implemented
Challenges	The challenges that are encountered in the implementation of the technologies
Benefits	The benefits/advantages brought by the applications of the technologies
Recommendations	What are the recommended research areas for future works

4 Results

4.1 The distribution of publication by time frame

Figure 2 depicts the distribution of reviewed papers published from 2017 to 2022. There were no significant research studies related to this topic in 2017 and 2019. This is because the majority of studies focused on the implementation of smart campuses with sustainability and energy efficiency options [29]. There was a numerical increase in 2018, 2020, and 2021, reflecting an increased interest in this area. The decrease in the number of publications in 2022 is a function of time as the search includes only two months of that year.

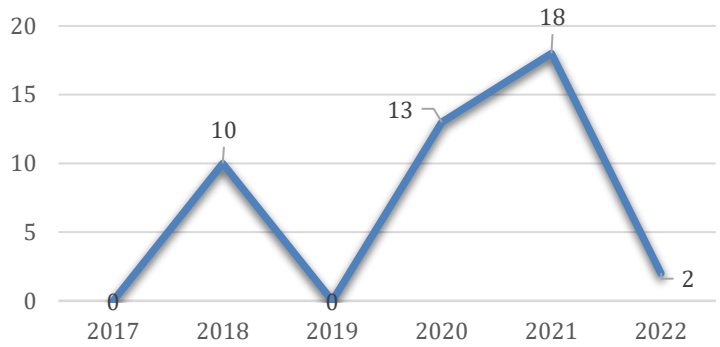


Fig. 2. The publications' distribution over the period 2017 – 2022

4.2 The geographical and demographic distribution of the studies

Figure 3 illustrates the distribution of the authors' countries per article. A significant number of authors are from Asia (n=29) followed by Europe (n=16) and South America (n=4). Asia and Europe combined, contributed 85% of all papers published. There is a great deal of research opportunity on the subject in North America and Africa, as each region published only 4% of the articles.

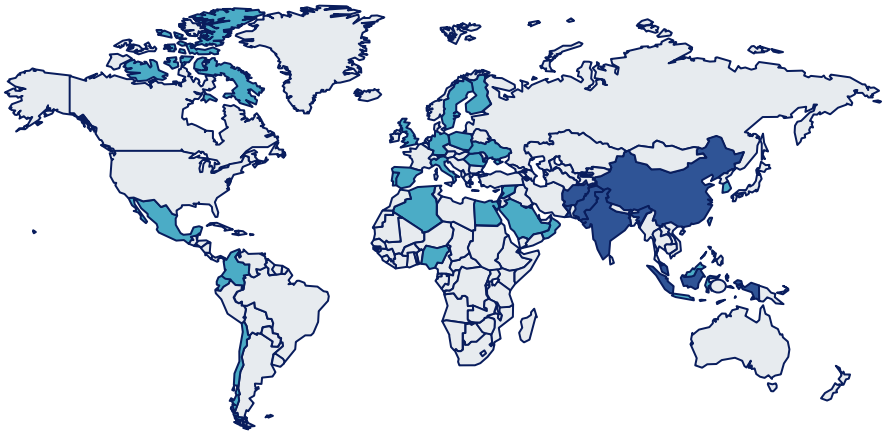


Fig. 3. Authorship geographical distribution of the selected studies

4.3 The research methodologies implemented

The distribution of methodologies in this study suggests that the IoT-based smart campus deployments have largely been conducted as experiments, opening up opportunities for real-world applications (see Figure 4). Moreover, most researchers have acknowledged that smart campuses are excellent testbeds for IoT implementation [29] [30].

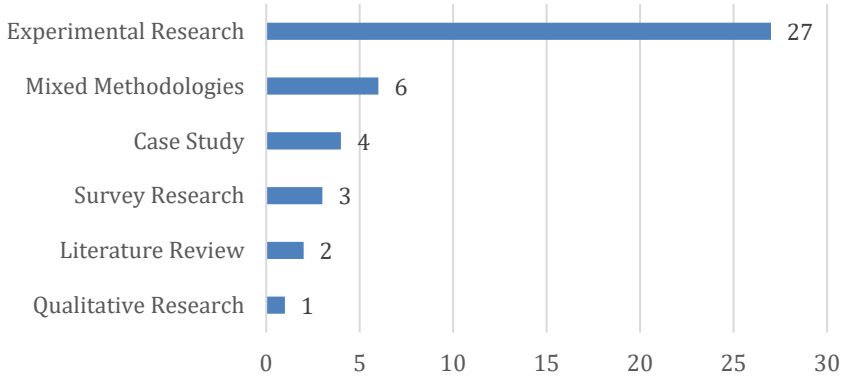


Fig. 4. The research methodologies implemented

4.4 The technologies required for the smart campus

A smart campus utilizes an IoT-enabled network infrastructure that synchronizes all data transmission and processing devices on a university campus (see Figure 5). IoT involves complexity and diversity and includes a variety of technologies [1]. Rico-Bautista [7] suggested four key smart technologies: Artificial Intelligence, Big Data, Cloud Computing, and the IoT.

- Artificial Intelligence enables machines to learn from experience and mimic human intelligence [23]. Using deep network technology, the authors developed a campus virtual assistant that is emotionally aware.
- Big Data Analytics has become instrumental in analyzing large and complex data sets that are used for the improvement of students' learning experiences [1].
- Cloud computing is among the main technologies that enable infrastructure, software, and platforms to operate together using common logic in a smart campus [22]. It is valuable in keeping the information in a central and safe place [7].
- Communication networks are applied to the smart campus to enable the transmission of information. The most common communication networks include Wi-Fi, 3G, and 4G/LTE [18]. On the other hand, Xu et al. [31] proposed an online teaching platform based on a 5G network to improve the learning experience. Furthermore, Jurva et al. [14] expected a 5G network together with IoT sensor networks and big data analytics to transform the education sector.

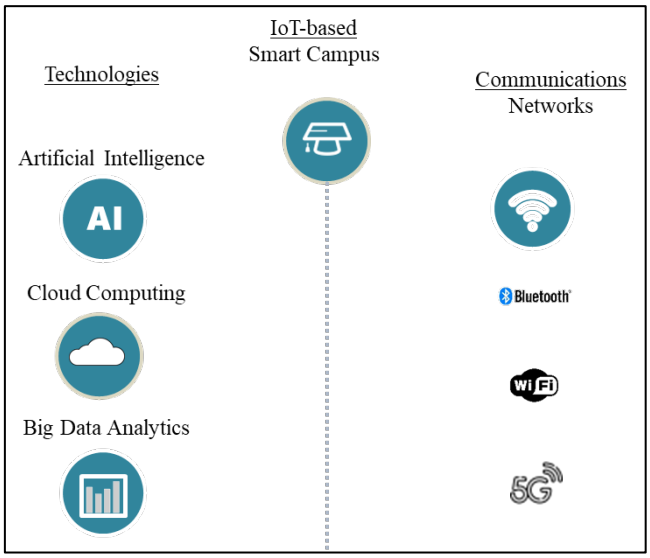


Fig. 5. The technologies required for the smart campus

4.5 The advantages/benefits of deploying IoT in a smart campus

The research findings highlight numerous benefits and advantages brought by the applications of IoT technologies on a smart campus. The main benefits of an IoT-based smart campus include agility, cost efficiencies, flexibility, interaction, scalability, resilience, the creation of intelligent classrooms, and the stimulation of creativity to support personalized learning, to list but a few [8]. With IoT deployment, access control systems can manage access control and provide enhanced security to the university community. Comprehensive campus surveillance and real-time incident warning are important applications to improve security standards and campus safety [32] [33]. The biggest advantage of an IoT-based smart campus is that it enhances campus management efficiencies [1], improves response times, and elevates user experience [19]. Additionally, an IoT-based campus enables the sharing of important educational resources and the delivery of interactive and creative services to the campus community and external stakeholders. It has an enormous potential to transform the existing teaching models to achieve desired innovations [5]. For example, Lin et al. [16] described an IoT application that enables students not majoring in computer science to create their innovations without coding. Noor et al. [34] presented another interesting innovation, finding innovative ways to improve the campus bus management service by predicting the shuttle travel times, fuel consumption, and harmful emissions. Furthermore, an IoT-based smart campus delivers rich content that makes learning more interesting [9] and produces learning-enthusiastic students and better-quality human resources [2]. An IoT-based smart campus combines physical space and technology to enhance student-teacher relationships resulting in improved communication and collaboration, as well as the promotion of personalized learning [24]. A key role for IoT in advancing the educational environment in universities is to improve teaching staff and educational flexibility [25] as well as deliver adaptive learning to support students with disabilities and learning challenges [8]. Also, they stated that it connects people (students, teachers, and administrators), processes, devices, and data enabling stakeholders in education to turn data collected from sensors and portable devices into valuable information for decision-making. Its full usage can greatly reduce the workload of the administrative staff [31] and enhance operational effectiveness by saving time and cost for the university management processes [33]. Furthermore, sustainable and responsible management of buildings using IoT technologies can minimize energy consumption and environmental footprint during construction, usage, and decommissioning [6]. IoT is primarily about digitizing everyday activities, so it has a very broad range of applications and market opportunities [1]. Table 3 summarizes the advantages and benefits of IoT applications spread across the seven smart areas.

Table 3. The advantages/benefits of deploying IoT applications in a smart campus

Smart Area	Benefits
Smart Environment	● Efficient measurement of consumption and conservation of energy and water conservation. ● Real-time surveillance to ensure safety within the parameters of the campus estate. ● Enhancing environmental sustainability by reducing the temperature in the environment. ● Optimization of waste management
Smart People	● Accurate recording of attendance for students and teaching activities by the academic staff. ● Reduction in the online sign-in time and improvement in the delivery of learning material. ● Improvement is the student's attitude towards learning. ● Strengthened relationship between students and teachers
Smart Building	● Accurate occupancy detection and optimal utilization of space in the campus buildings ● Improvement in the quality of the indoor environment (temperature, noise pollution, lighting, ventilation, humidity). ● Automation of maintenance improves the response time to restoring functionalities of the university buildings.
Smart Living	● Accurate management of the parking space on campus grounds. ● Seamless access control to campus facilities ● Incorporation of teaching staff and students with learning facilities and the information generated by them.
Smart Governance	● The ability to make data-driven decisions to benefit the university community and external stakeholders. ● Improvement in the university services and the administrative management processes. ● Detecting the learning habits of the students to inform developments of the academic agenda.
Smart Mobility	● The ability to calculate fuel consumption and gas emissions by the campus shuttles. ● The ability to measure the travel time for all campus shuttles to facilitate better planning and enhance the quality of service.
Smart Economy	● The ability for students to create new mobile applications to contribute to the innovation efforts at their universities.

4.6 The challenges experienced in deploying IoT in a smart campus

Implementing an IoT-based smart campus offers many benefits, but also presents challenges including resistance to changing academic learning methods, high costs of smart applications, and privacy and data security issues [7] [18]. This systematic literature review identified that most of the existing approaches to smart campuses have inherent challenges that limit their applications [15] [35]. Chagnon-Lessard et al. [6] stated that these include "sustainability and energy issues, acceptability and ethics, learning models, open data policies and interoperability" (p.1). The five key barriers to overcome to implement IoT-based smart campuses are explored:

a) *Privacy and security issues*. Due to the interconnected nature of IoT devices, any device with poor security will potentially compromise network security and privacy. Moreover, the full potential of IoT depends on respect for privacy preferences [15] [36]).
b) *Operational issues.* The software accompanying many IoT devices may not necessarily integrate with the standard IoT gateways and protocols. Due to a lack of integration between the interfaces, failures are more likely to happen and detection times are longer [30] [11].
c) *Interoperability and integration*. IoT environments face many challenges due to increased connectivity. Interoperability allows IoT devices to communicate with each other (e.g., students-to-students, students-to-teacher, and teacher-to-teacher) and facilitate the integration of various components to improve the quality of communication [14].
d) *Energy and environmental issues*. Physical environments such as humidity and high temperatures can adversely affect the performance of IoT devices. There is a need for operations to enable autonomous detection, prevention, and improvement of issues at certain scales without human intervention. The IoT devices are energy-intensive and deployments of IoT applications required energy consumption efficiencies [18] [37] [10] [38].
e) *Legal and compliance issues*. The implementation of IoT-based devices raises many legal and compliance issues including cross-border data flows, data misuse, and Internet legal frameworks [15].

5 Discussion

A smart campus is an outcome of rapid developments in technology to deliver quality services [25] and achieve advanced management on a university campus [21] [39,40]. The development of a smart campus requires the integration of existing information systems and IoT technologies to create a holistic and intelligent platform [1]. By leveraging technology, the university can improve processes while extending control over actions that are otherwise performed by people [19]. The universities face the challenge of delivering quality education efficiently through digitalization, which allows for streamlining academic processes and the development of smart services. Due to the outbreak of the Covid-19 pandemic, universities around the globe are using new technologies to transform their teaching methodologies. Consequently, many students engaged in some kind of remote education and are aware of the several advantages and possibilities offered by various teaching and learning methods [6]. With the aid of e-learning concepts and digital technologies, students could continue their educational pursuits safely from a distance [41].

There are numerous advantages and benefits to using IoT applications across the university campus [3]. Students want a learning environment that is technically advanced and content-rich. In the same way, universities are becoming intelligent campuses and technology is becoming the major factor in their growth [19]. It enables the

development of smart classroom teaching [42-45] that facilitates both individual learning and interactive learning [24]. It plays a pivotal role in facilitating fast access to educational services [10] which results in the digitization of university teaching [3]. Additionally, Fu, Chen, and Cheng [46] explored the integration of wearable smart devices that leverage the power of computer graphics and image technology to enhance students' learning enthusiasm and improve participation in the classroom.

In the administration of the university, the management of physical resources enables the university to implement innovative educational models. On the other hand, the management of academic resources is more complex since it includes variables for measuring the development of learning and the discovery of paradigms like identifying the learning habits of students [35] [47-50]. Missed opportunities or financial losses can be attributed to poor management of these resources. Therefore, the utilization of real-time data monitoring and dynamic data visualization on dashboards are powerful tools in the decision-making process [13] [52,53]. The university campus usually consists of large energy-intensive buildings. The use of sensors, actuators, metering devices, and various forms of network activities [38] facilitates the operation and management of such buildings [10] for energy conservation and environmental sustainability [29]. Several studies have shown that smart campuses have successfully deployed IoT-based environmental monitoring systems. The integration of the Building Energy Management System (BEMS) with IoT sensors facilitates the monitoring of indoor conditions and optimizes energy use in university residences [53] [54]. The deployment of an irrigation system that uses IoT nodes to collect environmental data such as soil and air temperatures and activate the system remotely through intelligent automated actions [55][56]. An installation of a green rooftop using LoRa to monitor and sense temperature changes as well as to minimize energy consumption [57]. The above studies focused on university buildings where cost optimization and cost savings were the main goals for integrating IoT, BEMS systems, and other advanced technologies. Moreover, a green campus with long-term sustainability can be achieved with the characteristics of IoT technology.

Disaster management is another underexplored area. Several disasters like fire, storms, floods, and earthquakes can occur on a university campus resulting in huge losses including human life. Ali et al. [37] suggested the implementation of an affordable IoT-based disaster management solution to escape these kinds of disasters. Furthermore, comfort and space are essential elements for successful learning [58] and social advancement [17][59][60]. In this area, the efficient management of open spaces and occupancy of university buildings is one of the beneficiaries of IoT applications [19][61][62]. Scientists are exploring the potential synergies between IoT and Building Information Modeling (BIM) in the environmental monitoring and emotion detection fields to provide insights into comfort levels, the researchers are exploring the potential synergies between the two technologies. The authors further explore the ability of universities to contribute to local sustainability projects by sharing knowledge and experience across a multi-disciplinary team. Lastly, an intelligent bus dispatch system improves campus bus operations by improving efficiency [63] and optimization of bus routes [34] as well as improving the bus user experience [19].

The most significant obstacles encountered with the IoT application in a smart campus are concerns about data security and dependability, as well as operational challenges [31][64][65]. Additionally, Mircea, Stoica, and Ghilic-Micu [8] stated that the dependence on excessive technology might result in vulnerabilities of information systems and IT infrastructures in education. To implement IoT-based smart campuses, these are the greatest barriers to overcome. Nonetheless, IoT continues to play a vibrant contribution in the future and the improvement of education reforms [25] and universities can increase both their long-term success as well as the quality campus experiences that their students have [66].

6 Conclusion and future works

In response to the plethora of issues affecting service delivery at universities, smart campuses have gained increased popularity. The combination of IoT technologies, sensors, and computer networks has enhanced the development of a smart campus. In this study, the existing literature on IoT applications that will enable a smart campus has been systematically reviewed. The results revealed that a smart campus is developing, yet the important concept that is driving informatization and digitization in higher education. Moreover, the advanced technologies including IoT, big data analytics, cloud computing, and artificial intelligence complement each other in the construction of a smart campus.

A smart campus is a sustainable and connected environment that aims to enhance education, experience, and efficiency. Through interconnected devices and IoT technologies, a smart campus can facilitate communication and open many opportunities for performance management in numerous areas of the university campus. Despite its many advantages and benefits, the IoT-based smart campus presents some challenges that deserve further exploration. The challenges of rising electricity costs and environmental impacts are clear motivators for achieving efficiency and sustainability goals. Future research should analyze the energy consumption of IoT deployments from a cost-effectiveness perspective. Furthermore, the study will benefit researchers, policymakers, teachers, and students by gaining insights into the IoT-based smart campus. However, like many other systematic literature reviews, this study has limitations that are associated with many others. Firstly, the selection of the studies was limited to the last five years. Secondly, this review was limited to publications from three databases. Thirdly, the review included only peer-reviewed studies available in full text. Future research may expand the inclusion criteria to include other scientific disciplines and extend the study period to at least ten years to determine if additional studies are relevant.

7 References

[1] Guo, G. (2018). Design and implementation of smart campus automatic settlement PLC control system for Internet of Things. IEEE Access, 6, 62601-62611. https://doi.org/10.1109/access.2018.2877023

[2] Madyatmadja, E. D., Yulia, T. R., Sembiring, D. J. M., & Angin, S. P. (2021). IoT usage on smart campus: a systematic literature review. International Journal of Emerging Technology and Advanced Engineering., 11(05). https://doi.org/10.46338/ijetae0521_06

[3] Xu, X., Wang, Y., & Yu, S. (2018). Teaching performance evaluation in smart campus. IEEE Access, 6, 77754-77766. https://doi.org/10.1109/access.2018.2884022

[4] Liang, Y., & Chen, Z. (2018). Intelligent and real-time data acquisition for medical monitoring in smart campus. IEEE Access, 6, 74836-74846. https://doi.org/10.1109/access.2018.2883106

[5] Gao, M. (2022). Smart campus teaching system based on ZigBee wireless sensor network. Alexandria Engineering Journal, 61(4), 2625-2635. https://doi.org/10.1016/j.aej.2021.09.001

[6] Chagnon-Lessard N., Gosselin L., Barnabe S., Bello-Ochende T., Fendt S., Goers S., Silva L. C. P. D., Schweiger B., Simmons R., Vandersickel A. and Zhang P. (2021). Smart campuses: Extensive review of the last decade of research and current challenges. IEEE Access, vol. 9, pp. 124200-124234, 2021. https://doi.org/10.1109/access.2021.3109516

[7] Rico-Bautista D., Guerrero C. D., Collazos C. A., Maestre-Góngora G., Hurtado-Alegría J. A., Medina-Cárdenas Y. and Swaminathan J. (2021). Smart university: A vision of technology adoption. Revista Colombiana de Computación, vol. 22, no. 1, pp. 44-55. https://doi.org/10.29375/25392115.4153

[8] Mircea, M., Stoica, M., & Ghilic-Micu, B. (2021). Investigating the impact of the internet of things in higher education environment. IEEE Access, 9, 33396-33409. https://doi.org/10.1109/access.2021.3060964

[9] Martínez, I., Zalba, B., Trillo-Lado, R., Blanco, T., Cambra, D., & Casas, R. (2021). Internet of Things (IoT) as Sustainable Development Goals (SDG) Enabling Technology towards Smart Readiness Indicators (SRI) for University Buildings. Sustainability, 13(14), 7647. https://doi.org/10.3390/su13147647

[10] Azizi, S., Nair, G., Rabiee, R., & Olofsson, T. (2020). Application of Internet of Things in academic buildings for space use efficiency using occupancy and booking data. Building and environment, 186, 107355. https://doi.org/10.1016/j.buildenv.2020.107355

[11] Villegas-Ch, W., Palacios-Pacheco, X., & Román-Cañizares, M. (2020). Integration of IoT and Blockchain to in the Processes of a University Campus. Sustainability, 12(12), 4970. https://doi.org/10.3390/su12124970

[12] Zhou, Z., Yu, H., & Shi, H. (2020). Optimization of wireless video surveillance system for smart campus based on internet of things. IEEE Access, 8, 136434-136448. https://doi.org/10.1109/access.2020.3011951

[13] Valks, B., Arkesteijn, M., Koutamanis, A., & Den Heijer, A. (2021). Towards smart campus management: Defining information requirements for decision making through dashboard design. Buildings, 11(5), 201. https://doi.org/10.3390/buildings11050201

[14] Jurva R., Matinmikko-Blue M., Niemelä V. and Nenonen S. (2020). Architecture and operational model for smart campus digital infrastructure. Wireless Personal Communications, vol. 113, pp. 1437-1454, 2020. https://doi.org/10.1007/s11277-020-07221-5

[15] Anagnostopoulos, T., Kostakos, P., Zaslavsky, A., Kantzavelou, I., Tsotsolas, N., Salmon, I., ... & Harle, R. (2021). Challenges and Solutions of Surveillance Systems in IoT-Enabled

Smart Campus: A Survey. IEEE Access, 9, 131926-131954. https://doi.org/10.1109/ACCESS.2021.3114447

[16] Lin, Y. B., Chen, L. K., Shieh, M. Z., Lin, Y. W., & Yen, T. H. (2018). CampusTalk: IoT devices and their interesting features on campus applications. IEEE Access, 6, 26036-26046. https://doi.org/10.1109/access.2018.2832222

[17] Zaballos, A., Briones, A., Massa, A., Centelles, P., & Caballero, V. (2020). A smart campus' digital twin for sustainable comfort monitoring. Sustainability, 12(21), 9196. https://doi.org/10.3390/su12219196

[18] Ahmed, V., Abu Alnaaj, K., & Saboor, S. (2020). An investigation into stakeholders' perception of smart campus criteria: the American university of Sharjah as a case study. Sustainability, 12(12), 5187. https://doi.org/10.3390/su12125187

[19] Villegas-Ch, W., Palacios-Pacheco, X., & Román-Cañizares, M. (2020). An internet of things model for improving process management on university campus. Future Internet, 12(10), 162. https://doi.org/10.3390/fi12100162

[20] Longo, E., Sahin, F. A., Redondi, A. E., Bolzan, P., Bianchini, M., & Maffei, S. (2021). A 5G-Enabled Smart Waste Management System for University Campus. Sensors, 21(24), 8278. https://doi.org/10.3390/s21248278

[21] Yang, A. M., Li, S. S., Ren, C. H., Liu, H. X., Han, Y., & Liu, L. (2018). Situational awareness system in the smart campus. Ieee Access, 6, 63976-63986. https://doi.org/10.1109/access.2018.2877428

[22] Berkane, M. L., Boufaida, M., & Bouzerzour, N. E. H. (2020). Modelling elastic scaling of cloud with energy-efficiency: Application to smart-university. Journal of King Saud University-Computer and Information Sciences. https://doi.org/10.1016/j.jksuci.2020.11.025

[23] Chiu, P. S., Chang, J. W., Lee, M. C., Chen, C. H., & Lee, D. S. (2020). Enabling intelligent environment by the design of emotionally aware virtual assistant: A case of smart campus. IEEE Access, 8, 62032-62041. https://doi.org/10.1109/access.2020.2984383

[24] Liu, J., Wang, C., & Xiao, X. (2021). Internet of things (IoT) technology for the development of intelligent decision support education platform. Scientific Programming, 2021. https://doi.org/10.1155/2021/6482088

[25] Razzaq, M. A., Mahar, J. A., Ahmad, M., Saher, N., Mehmood, A., & Choi, G. S. (2021). Hybrid auto-scaled service-cloud-based predictive workload modeling and analysis for smart campus system. IEEE Access, 9, 42081-42089. https://doi.org/10.1109/access.2021.3065597

[26] Kitchenham B. and Charters S. (2007). Guidelines for performing systematic literature reviews in software engineering. Technical Report EBSE 2007-001, Keele University and Durham University Joint Report. https://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

[27] Lame, G. (2019, July). Systematic literature reviews: An introduction. In Proceedings of the design society: international conference on engineering design (Vol. 1, No. 1, pp. 1633-1642). Cambridge University Press. https://doi.org/10.1017/dsi.2019.169

[28] Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Systematic reviews, 10(1), 1-11. https://doi.org/10.1136/bmj.n71

[29] Moura, P., Moreno, J. I., López Bouton, G., & Alvarez-Campana, M. (2021). IoT platform for energy sustainability in university campuses. Sensors, 21(2), 357. https://doi.org/10.3390/s21020357

[30] Dave, B., Buda, A., Nurminen, A., & Främling, K. (2018). A framework for integrating BIM and IoT through open standards. Automation in Construction, 95, 35-45. https://doi.org/10.1016/J.AUTCON.2018.07.022

[31] Xu, X., Li, D., Sun, M., Yang, S., Yu, S., Manogaran, G., ... & Mavromoustakis, C. X. (2019). Research on key technologies of smart campus teaching platform based on 5G network. IEEE Access, 7, 20664-20675. https://doi.org/10.1109/access.2019.2894129

[32] Hamad, A. H. (2021). Smart Campus Monitoring Based Video Surveillance using Haar Like Features and K-Nearest Neighbour. International Journal of Computing and Digital Systems, 10. https://doi.org/10.12785/ijcds/100179

[33] Chen, L. W., Chen, T. P., Chen, D. E., Liu, J. X., & Tsai, M. F. (2018). Smart campus care and guiding with dedicated video footprinting through Internet of Things technologies. IEEE Access, 6, 43956-43966. https://doi.org/10.1109/access.2018.2856251

[34] Noor, R. M., Rasyidi, N. B. G., Nandy, T., & Kolandaisamy, R. (2020). Campus shuttle bus route optimization using machine learning predictive analysis: A case study. Sustainability, 13(1), 225. https://doi.org/10.3390/su13010225

[35] Gilman, E., Tamminen, S., Yasmin, R., Ristimella, E., Peltonen, E., Harju, M., ... & Pirttikangas, S. (2020). Internet of things for smart spaces: A university campus case study. Sensors, 20(13), 3716. http://doi.org/10.3390/s20133716

[36] Zheng, L., Song, C., Cao, N., Li, Z., Zhou, W., Chen, J., & Meng, L. (2018). A new mutual authentication protocol in mobile RFID for smart campus. IEEE Access, 6, 60996-61005. https://doi.org/10.1109/ACCESS.2018.2875973

[37] Ali, Z., Shah, M. A., Almogren, A., Ud Din, I., Maple, C., & Khattak, H. A. (2020). Named data networking for efficient IoT-based disaster management in a smart campus. Sustainability, 12(8), 3088. https://doi.org/10.3390/su12083088

[38] Eltamaly A. M., Alotaibi M. A., Alolah A. I. and Ahmed M. A. (2021). IoT-based hybrid renewable energy system for smart campus. Sustainability, vol. 13, no. 15, 8555. https://doi.org/10.3390/su13158555

[39] Rami S., Bennani S., and Khalidi Idrissi M. (2022). Cognitive Learning Style Detection in e-Learning Environments using Artificial Neural Network. Int. J. Emerg. Technol. Learn., vol. 17, no. 17, pp. pp. 62–77, Sep. 2022. https://doi.org/10.3991/ijet.v17i17.30243

[40] Williams, M. T., Lluka, L. J., & Chunduri, P. (2021). Redesigning a First Year Physiology Course using Learning Analytics to Improve Student Performance. International Journal of Learning Analytics and Artificial Intelligence for Education (iJAI), 3(1), pp. 4–19. https://doi.org/10.3991/ijai.v3i1.21799

[41] Rahmani A. M., Ali Naqvi R., Hussain Malik M., Malik T. S., Sadrishojaei M., Hosseinzadeh M. and Al-Musawi A. (2021). E-learning development based on Internet of Things and Blockchain technology during COVID-19 Pandemic. Mathematics, vol. 9, 3151, 2021. https://doi.org/10.3390/math9243151

[42] Nai, R. (2022). The design of smart classroom for modern college English teaching under Internet of Things. Plos one, 17(2), e0264176. https://doi.org/10.1371/journal.pone.0264176

[43] Akcil, U., Uzunboylu, H. and Kinik, E., (2021). Integration of Technology to Learning-Teaching Processes and Google Workspace Tools: A Literature Review. Sustainability, 13(9), p.5018. https://doi.org/10.3390/su13095018

[44] Al-Zoubi, A. Y., Tahat, A.., Wahsheh, R., Taha, M.., Al-Tarawneh, L.., & Hasan, O. (2022). A Bachelor Degree Program in IoT Engineering: Accreditation Constraints and Market Demand. International Journal of Engineering Pedagogy (iJEP), 12(4), pp. 17–34. https://doi.org/10.3991/ijep.v12i4.31429

[45] Zhang, M., & Li, X. (2021). Design of smart classroom system based on Internet of things technology and smart classroom. Mobile Information Systems, 2021. https://doi.org/10.1155/2021/5438878

[46] Fu, D., Chen, L., & Cheng, Z. (2021). Integration of wearable smart devices and Internet of Things technology into public physical education. Mobile Information Systems, 2021. https://doi.org/10.1155/2021/6740987
[47] Fitsumbirhan, G., Asrat, A., & Kelkay, A. D. (2020). Data-based decision-making practices in secondary schools of North Gondar, Ethiopia. Global Journal of Guidance and Counseling in Schools: Current Perspectives, 10(1), 36–48. https://doi.org/10.18844/gjgc.v10i1.4564
[48] Mohammed, A. B. (2020). Comparative analysis of clustering techniques in the Internet of Things. Global Journal of Information Technology: Emerging Technologies, 10(2), 106–112. https://doi.org/10.18844/gjit.v10i2.4746
[49] Xu, B. & Margevica-Grinberga, I. (2021). A Discourse on Innovation of English Teaching in China from the Perspective of Artificial Intelligence. Cypriot Journal of Educational Sciences, 16(5), 2313–2323. https://doi.org/10.18844/cjes.v16i5.6347
[50] Gaudio, G. del, Refugio, C. N., Jurcic, I., Corte, V. D., James, D. F., Said, M. M. T., Sawicka, B., Mohan, T. R., Aravind, V. R., Umachandran, K., & Amuthalakshmi, P. (2019). Designing learning-skills towards industry 4.0. World Journal on Educational Technology: Current Issues, 11(2), 150–161. https://doi.org/10.18844/wjet.v11i2.4147
[51] Alfa, M. T., Medayese, S. O., & Owoyale, O. A. (2019). Space configuration and learning comfort; a case study of Federal University of Technology Minna lecture halls. Contemporary Educational Researches Journal, 9(1), 20–31. https://doi.org/10.18844/cerj.v9i1.4058
[52] Discutido, R., & Especi, J. (2022). Development and evaluation of multiple intelligence-based differentiated instructional material for reading and writing. International Journal of Learning and Teaching, 14(4), 173–180. https://doi.org/10.18844/ijlt.v14i4.7541
[53] Hossain, M., Weng, Z., Schiano-Phan, R., Scott, D., & Lau, B. (2020). Application of IoT and BEMS to visualise the environmental performance of an educational building. Energies, 13(15), 4009. https://doi.org/10.3390/en13154009
[54] Mohamad Said, Z., & Zolkipli, M. F. (2022). Internet of Things (IoT): A Study of Security Issues and Challenges. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 10(02), pp. 16–31. https://doi.org/10.3991/ijes.v10i02.29301
[55] Froiz-Míguez I., López-Iturri P., Fraga-Lamas P., Celaya-Echarri M., Blanco-Novoa Ó., Azpilicueta L., Falcone F. and Fernández-Caramés T. M., (2020). Design, implementation, and empirical validation of an IoT smart irrigation system for Fog computing applications based on LoRa and LoRaWAN sensor nodes. Sensors, vol. 20, no. 23, 6865. https://doi.org/10.3390/s20236865
[56] Carraro, K., & Trinder, R. (2021). Technology in formal and informal learning environments: Student perspectives. Global Journal of Foreign Language Teaching, 11(1), 39–50. https://doi.org/10.18844/gjflt.v11i1.5219
[57] Tseng, K. H., Chung, M. Y., Chen, L. H., & Chang, P. Y. (2021). Green smart campus monitoring and detection using LoRa. Sensors, 21(19), 6582. https://doi.org/10.3390/s21196582
[58] Çavuş, N. (2020). Evaluation of MoblrN m-learning system: Participants' attitudes and opinions. World Journal on Educational Technology: Current Issues, 12(3), 150-164. https://doi.org/10.18844/wjet.v12i3.4978
[59] Mostefai, M., Miloud, Y., & Miloudi, A. (2019). Evaluation of five various technologies of PV panels for Si production using Sahara sand silica source. World Journal of Environmental Research, 9(2), 36–45. https://doi.org/10.18844/wjer.v9i2.4626
[60] Simsek, N. Y., Haznedar, B., & Kuzudisli, C. (2020). A comparative study of different classification algorithms on RNA-Seq cancer data. New Trends and Issues Proceedings on Advances in Pure and Applied Sciences, (12), 24–35. https://doi.org/10.18844/gjpaas.v0i12.4983
[61] Maniam, G., Sampe, J., Jaafar, R., Hamzah, A. A., & Mohamad Zin, N. (2022). Bio-FET Sensor Interface Module for COVID-19 Monitoring Using IoT. International Journal of

Online and Biomedical Engineering (iJOE), 18(12), pp. 70–88. https://doi.org/10.3991/ijoe.v18i12.31877

[62] Bianco, N. D.., Giaconi, C., Gison, G., D'Angelo, I., & Capellini, S. A. (2021). Inclusion at the University through technology: A case study in Italy. International Journal of Special Education and Information Technologies, 7(1), 01–15. https://doi.org/10.18844/jeset.v7i1.6793

[63] Feng, X., Zhang, J., Chen, J., Wang, G., Zhang, L., & Li, R. (2018). Design of intelligent bus positioning based on Internet of Things for smart campus. IEEE Access, 6, 60005-60015. https://doi.org/10.1109/access.2018.2874083

[64] Pascu, L., Simo, A., & Vernica, A. M. (2019). Integrating Microsoft IoT, machine learning in a large-scale power meter reading. International Journal of New Trends in Social Sciences, 3(1), 10–16. https://doi.org/10.18844/ijntss.v3i1.3815

[65] Uzunboylu, H., & Gundogdu, E. G. (2018). A Content Analysis Study on Pre-School Education and Instructional Technologies. International Journal of Innovative Research in Education, 5(4), 119–128. https://doi.org/10.18844/ijire.v5i4.3974

[66] Mbombo, A. B., & Cavus, N. (2021). Smart university: A university in the technological age. TEM Journal, 10(1), 13-17. https://doi.org/10.18421/TEM101-02

8 Authors

Nadire Cavus is a professor of Computer Information Systems and director of the Computer Information Systems Research and Technology Centre at the Near East University in Cyprus. She is the chairperson of the Department of Computer Information Systems. She received his Ph.D. in Computer Information Systems from the Faculty of Economics and Administrative Sciences, Near East University, Cyprus in 2007. Her research areas include mobile learning, e-learning, technology-based learning, learning management systems, new trends in IT, and digital transformation (email: nadire.cavus@neu.edu.tr).

Seipati Elizabeth Mrwebi is a Ph.D. candidate in Innovation and Knowledge Management from Near East University in Cyprus. She is currently working on her Ph.D. thesis. Her research focuses on e-learning, technology, innovation management, knowledge management, and digitalization (email: 20213322 @std.neu.edu.tr).

Imran Ibrahim is a Master's degree student in Computer Information Systems from Near East University in Cyprus. He is currently working on his Master's thesis. His research focuses on e-learning, new technologies, big data, and digital transformation (email: 20213609@std.neu.edu.tr).

Temiloluwa Modupeola is a Master's degree student in Computer Information Systems from Near East University in Cyprus. He is currently working on his Master's thesis. His research focuses on distance learning, digital transformation, and IoT (email: 20214394@std.neu.edu.tr).

Albert Y. Reeves is a student Master's degree in Computer Information Systems from Near East University in Cyprus. He is currently working on his Master's thesis. His research focuses on e-learning, technology adoption, and IoT (email: 20206951@std.neu.edu.tr).

Article submitted 2022-08-23. Resubmitted 2022-10-03. Final acceptance 2022-10-10. Final version published as submitted by the authors.

The Use of Mobile Learning Technologies for an Online Mathematics Course: Student Opinions in The Pandemic Process

https://doi.org/10.3991/ijim.v16i23.36209

Murat Tezer[1(✉)], Meryem Gülyaz[1,2]
[1] Department of Mathematics Education, Near East University, Nicosia, Northern Cyprus
[2] Ministry of Education and Culture, Nicosia, Turkish Republic of Northern Cyprus
murat.tezer@neu.edu.tr

Abstract—This study aims to examine the opinions of university students about using mobile learning Technologies in an online mathematics course during the pandemic (COVID-19) period. The participant group of the study consists of 266 university students studying at a private university. In the study, a mixed research method, in which quantitative and qualitative research methods are used, was used. A questionnaire form which was "Student Opinions Regarding Using Mobile Learning Technologies in an Online Mathematics Lesson During the Pandemic Process" created by the researchers and open-ended questions were used to reveal the opinions of the students about the online mathematics lesson. According to the results of the study, one can be seen that the majority of the students make an effort and spare time to understand mathematics in online lessons who use mobile learning technologies during the Covid-19 pandemic process. In addition, they argued that the majority of the students believe that they will be successful in the exam at the end of the online mathematics lesson by using mobile learning technologies and that it is easy to follow the mathematics lesson online using mobile learning technologies during the Covid-19 pandemic process, depending on the teacher giving the lesson. In addition, they stated the inadequacy of knowledge in the field of numeracy and the lack of technical infrastructure in distance education among the difficulties experienced by the students in the online mathematics course. As learning strategies in the virtual environment, the students stated that they did it again and again, watched the live lesson videos over and over, prepared an individual study program for themselves, took notes, attended regular classes, and watched educational videos by using mobile learning technologies.

Keywords—Covid-19, pandemic, mathematics lesson, online learning, learning strategies

1 Introduction

The coronavirus (COVID-19) emerged in Wuhan and then turned into a pandemic that affected the whole world and did not differentiate between people [1]. As it is

known, the Coronavirus (Covid-19) has affected the whole world, and we have gone through a difficult process around the world. There are some changes in this process, one of which is that education has started to be continued with distance education [2].

When we look at what's going on in this period, the long-term science and education that we all have to review our fields of work and perspective take its toll [3]. On top of that, closer relations can be established between such fields. In this context, it may be necessary to control emotions such as deep anxiety and hopelessness in processes such as the pandemic process [4].

There is a large literature on the closure of educational institutions to reduce the spread during the pandemic process. To prevent the emergence of infectious diseases in society by breaking this meeting chain, the transition to distance education was made without a break. Universities quickly switched to the mode of transferring many courses and programs to students as face-to-face online courses [5].

The distance education method has been integrated into the education system to eliminate the problems experienced in traditional education to some extent. This model, which is supported by the state in many countries as a solution to the disruptions in education, has recently been supported for purposes such as reducing the costs of education, lifelong education, and equal opportunity in education. Distance education is an education system that was born as an alternative to formal education without the limitation of time and place and in which technology is integrated today [6] - [8].

A fast and strong sustainable modern education approach has been adopted for the creation of online learning modules in the education process of university students of this pandemic [9] [23]. During the pandemic process, when distance education systems were used effectively, information was transferred to students quickly. Differences may occur in students' learning of mathematics. Therefore, this study aimed to reveal the opinions of university students about the online mathematics course during the pandemic process.

Early definitions of mobile learning are Palm, Windows CE machines, and digital as electronic learning (e-learning) with mobile digital devices such as mobile phones defined. In Keegan's technology-centered definition, limits mobile devices to those that are portable by users, and mobility emphasizes the concept. That mobile learning is mobile learning that women can easily carry in their bags and men in their pockets. learning from devices while the user is on the go. Today, the mobile Scope of learning by researchers an expanded and distinct paradigm shift is defined as. mobile in general learning, education without a specific place content, benefit from dynamically generated services and interact with others. allowing the user to communicate Immediate response to individual needs through mobile technologies that increase productivity and work performance efficiency by its educational method [10] – [11].

2 Method

In the research, university students' views on an online mathematics course who use mobile learning technologies were examined. In this study, the mixed method was used by using the survey method, which is one of the quantitative research methods, and the

interview method, which is one of the qualitative research methods. According to Büyüköztürk [12], studies aiming to collect data to determine certain characteristics of a group are called survey research. Mixed methods research is research in which the researcher collects and analyzes data, incorporates findings, and draws conclusions using qualitative and quantitative approaches or methods in a single study or research program [13].

2.1 Participants

Regarding the characteristics of a mixed research study, the number of participants was limited. Since the aim was not to generalize the findings, the study was conducted in a private school. The present study was carried out at the school where the researchers worked. This school was chosen because of its easy accessibility. 35.4% of the participants are female and 64.6% are male students.

2.2 Data collection tools

As a data collection tool in the study, the first part consists of the "Student Opinions Regarding Using Mobile Learning Technologies in an Online Mathematics Lesson During the Pandemic Process" questionnaire and the second part consists of open-ended questions. While preparing the questionnaire, the literature was used and the opinions of two experts in the field were taken and examined in terms of face validity. To apply the questionnaire form, necessary permissions were obtained via e-mail and the questionnaires were applied after obtaining permission. The first part of the questionnaire consists of 21 items and is in a 5-point Likert type. For each of the 21 items, it was asked to choose one of the states of strongly disagree, disagree, undecided, agree, and strongly agree. While calculating the questionnaire form score, 1, 2, 3, 4, and 5 points were given to the answers, respectively. In the study, the reliability test was applied to the scale and the Cronbach Alpha value was determined as 0.89 (good reliability). In the second part of the questionnaire, open-ended questions were included. Again, expert opinion was taken for the validity and reliability of the open-ended questions. Content analysis was carried out for the analysis of the obtained data.

Open-Ended Questions:

1. What kind of difficulties did you experience in learning mathematics online by using mobile learning technologies during the pandemic? (a) What prevented you from learning mathematics? (b)
2. What kind of study strategies have you identified for learning online mathematics by using mobile learning technologies during the pandemic?
3. What are your general views on learning mathematics online by using mobile learning technologies during the pandemic?

2.3 Data analysis

The collected data was transferred to the computer environment and the questionnaire was analyzed with the SPSS 24.00 program. To collect the data, a survey form was created via the survey Google Forms. First of all, frequency distribution was made for the survey results, and then the mean and standard deviation values of each item were calculated. For open-ended questions, content analysis was performed and frequency values were tabulated.

3 Findings

The findings obtained from the analysis of the data were presented in tables and comments were made according to the tables. The descriptive statistical findings of the "Student Opinions Regarding Using Mobile Learning Technologies in an Online Mathematics Lesson During the Pandemic Process" questionnaire form were given in Table 1 and the answers to open-ended questions were given in the other tables by making content analysis.

Table 1. "Student Opinions Regarding Using Mobile Learning Technologies in an Online Mathematics Lesson During the Pandemic Process" questionnaire form

UNITS	Arithmetic Mean	Standard Deviation
	X	Sd
During the pandemic, I make an effort to understand mathematics in online classes by using mobile learning technologies.	4.48	0.761
During the pandemic, I believe that I will be successful in the exam at the end of the online math lesson by using mobile learning technologies.	3.95	1.012
During the pandemic, I enjoy studying mathematics online by using mobile learning technologies.	3.84	0.942
During the pandemic, I try to learn more in online math classes by using mobile learning technologies.	4.16	0.895
During the pandemic, I often repeat my notes by using mobile learning technologies before the online class.	3.63	1.016
During the time of the pandemic, it is easy to follow the math lesson online by using mobile learning technologies.	4.01	1.145
During the pandemic, the online math course is easy to understand by using mobile learning technologies.	3.72	1.113
During the pandemic, the materials presented for the math lesson are useful for me to learn by using mobile learning technologies.	4.29	0.900
During the pandemic, I make time for an online math lesson by using mobile learning technologies.	4.44	0.773
During the pandemic, the online math lesson is more interesting to me by using mobile learning technologies.	3.42	1.261
During the pandemic, I often watch the content presented in the online mathematics course by using mobile learning technologies.	4.03	0.986
During the pandemic, I determined my study method for the online math lesson by using mobile learning technologies.	3.96	1.021

During the pandemic, I made a study plan by using mobile learning technologies for my online math lesson.	3.72	1.142
During the pandemic, I can not afford to fail an online math class by using mobile learning technologies.	4.77	0.687
During the pandemic, I have no motivation for an online math class if I do not use mobile technologies.	2.79	1.380
During the pandemic, I am worried that I will fail the online math class by using mobile learning technologies.	3.17	1.489
During the pandemic, I will not be successful even if I study for an online math lesson by using mobile learning technologies.	2.27	1.273
During the pandemic period, I do the homework and assignments given in the online mathematics course by using appropriate strategies and methods.	4.31	0.828
During the pandemic, I do not allow other activities to disrupt my study schedule in the online math class by using mobile learning technologies.	4.10	0.967
During the pandemic, I have a suitable home/dormitory environment to study the online math course by using mobile learning technologies.	4.02	1.173
During the pandemic, I try to stay away from the stimuli to study the online math course by using mobile learning technologies.	3.48	1.284
During the pandemic, I have difficulties using the system (UZEM) by using mobile learning technologies where the online mathematics course is located (connecting to the course, downloading videos, uploading files).	2.42	1.295
During the pandemic, I have difficulty expressing myself to my teacher by using mobile learning technologies in the online mathematics lesson compared to the normal classroom environment.	2.37	1.369
During the pandemic, my anxiety about the math lesson increased even more by using mobile learning technologies.	2.80	1.458
During the pandemic, I have difficulty learning math concepts and formulas by using mobile learning technologies.	2.76	1.317
During the pandemic, I contact other students by using mobile learning technologies who are taking math lessons to get help via social media.	3.26	1.338

According to Table 1, during the Covid-19 pandemic, the students stated that they answered "I absolutely agree" for the topics of making an effort to understand mathematics in online lessons by using mobile learning technologies and allocating time for an online mathematics lesson and that their conscience would not allow them to fail the lesson. In addition, during the pandemic period, the students' used appropriate strategies and methods in the assignments given in the online mathematics lesson by using mobile learning technologies, the materials presented for the mathematics lesson were useful for their learning, and they tried to learn more in the mathematics lessons by using mobile learning technologies, they did not allow other activities in the lesson to disrupt their study order, the students presented in the online mathematics lesson. They stated that they frequently watch the content by using mobile learning technologies and that they have a suitable home/dormitory environment to study the online mathematics course.

In addition to all these, it is easy to follow the online mathematics lesson by using mobile learning technologies, the students choose their study method for the online mathematics lesson, they believe that they will be successful in the exam at the end of the mathematics lesson by using mobile learning technologies, and they enjoy studying

the online mathematics lesson by using mobile learning technologies, it is easy to understand the lesson, they make a study plan for themselves by using mobile learning technologies, they stated that they often repeated their notes before the lesson, tried to stay away from stimuli to study the lesson, and stated that the lesson was more interesting for them by using mobile learning technologies.

During the pandemic, the students who took mathematics lessons did not always communicate to get help from other students on social media, they were undecided about their motivation, learning formulas, and being anxious by using mobile learning technologies. During the pandemic, the students stated that they had no difficulty in using the distance education system where the online mathematics course was available, that they had no difficulty in expressing themselves to the instructor in the online mathematics lesson compared to the normal classroom environment, and that they did not think that they would fail in the mathematics lesson by using mobile learning technologies.

In Table 2, it is seen that 33% of the students in the first place have difficulties in online mathematics lessons due to inadequacy in the numerical field. In other words, the students also stated that before they came to the university, their lack of mathematics background prevented them from learning the course. In the second place, there are expressions such as technical problems, pandemic anxiety, inability to adapt to online lessons at home, not being motivated, and unable to express themselves by using mobile learning technologies.

Table 2. Student views on what kind of difficulties they experienced in learning mathematics during the pandemic by using mobile learning technologies

Opinions	f	%
No difficulty	9	3
Having a lesson conflict	12	5
İntensive program	14	5.5
İnability to Express oneself	15	6
İnability to concentrate	18	7
Inability to adapt to the home environment	25	9
Pandemic anxiety	32	12
Technical issues	52	19.5
Lack of background in maths	89	33
Total	266	100

Table 3 contains the students' opinions regarding the difficulties mentioned. According to these opinions, although 5% state that there is no difficulty, virtual environment problems and power outages are among the biggest reasons. In addition, among the technical problems, problems in the internet infrastructure and COVID-19 follow other problems.

Table 3. Student views on the reasons that prevent learning mathematics

Reasons	f	%
Giving more homework and projects	12	5
Why not	12	5
Covid-19	35	13
İnternet infrastructure problems	48	18
Power cut	65	24
Virtual environment	94	35
Total	266	100

Table 4 shows the study strategies developed by students for learning online mathematics by using mobile learning technologies. Considering the frequency values in the table, it was seen that the students preferred strategies such as doing a lot of repetition and watching the live lesson videos over and over by using mobile learning technologies. In addition, it is among the findings that they developed strategies by preparing an individual study program, taking notes, attending regular classes, and watching educational videos by using mobile learning technologies.

Table 4. Study strategies for learning mathematics online during the pandemic

Opinions	f	%
I couldn't determine the strategy	13	5
Watching educational videos	17	6
Take notes	19	7
Attend regular classes	23	9
Studying regularly	28	11
Note down the lectures in the notebook	33	12
Preparing an individual study program	38	14
Watching live lecture videos recorded over and over	45	17
Do a lot of repetition	50	19
Total	266	100

Table 5 shows the general views of students on learning online mathematics during the pandemic by using mobile learning technologies. Among these opinions, it has been revealed that the most important factor facilitating online mathematics lessons with a frequency value of 17% is the lesson teacher. In addition, it has been argued that since the mathematics course is a numerical course, it cannot be efficient in distance education and it can be beneficial by watching the course videos again and again by using mobile learning technologies.

Table 5. Student views on learning online mathematics during the pandemic by using mobile learning technologies

Opinions	f	%
All courses except applied courses should be given by distance education.	2	0.8
Not disrupting education even in difficult times.	8	3
Mathematics lessons should not be in the form of distance education.	12	5
Too much workload.	14	5.2
Being a process that drains all energy.	16	6
Be a difficult process.	21	8
Not like face-to-face training.	24	9
Distance Education is efficient, but its application in mathematics lags.	26	9.5
It is difficult in the distance education stage because it is a numerical course.	28	10.5
Listening to lectures over and over is very productive.	30	11
The most important factor facilitating distance education is the course.	40	15
It is necessary to have sufficient experience to adapt to distance education.	45	17
Total	266	100

4 Discussion

According to the results of the study, by Başar et al. [14] similarly, we see that students have different perceptions. These perceptions include both positive and negative statements. These findings were performed by Bayram et al. [15] showing parallelism with the study. We see that the majority of students are undecided about making an effort and taking time to understand mathematics in online classes during the Covid-19 pandemic process by using mobile learning technologies. In addition, it was concluded that the majority of the students were undecided about believing that they would be successful in the exam at the end of the online mathematics course by using mobile learning technologies.

Genç et al. [16]'s findings show that we have obtained the same results. In addition, we see in the results of the study that they developed a strategy of listening to the live lesson videos again and again. In line with the opinions of the students, the opinion that online mathematics lessons are difficult in the virtual environment by using mobile learning technologies Karatepe et al. [17] was found to be the same as the findings. In addition, Karakuş et al. [18], it was concluded that technical problems (internet and power outages, etc.) were among the difficulties experienced by the students in the first place.

The same conclusion was reached with the study of Cumhur and Tezer [19], emphasizing that the most important factor in students' online mathematics lessons, as in face-to-face education, is the teacher (educator) factor and that the ease of the lesson depends on this factor. In addition, pandemic anxiety has a negative effect on learning mathematics and this causes online mathematics lessons to be a non-positive cause of the difficulty. This result, on the other hand, is in parallel with the study of Cumhur and Tezer, and it is seen that anxiety has negative effects on students in

learning mathematics. To eliminate this inequality, which is defined as the digital divide by the OECD (2021), it is necessary to strengthen the internet and mobile technologies infrastructure, expand access to information and communication technologies, and develop individuals in this regard (Öztürk, 2005)[20].

Korucu and Biçer (2019)[21] and Koparan and Yılmaz (2020)[22] stated that the mobile learning environment is beneficial and motivating since it contributes positively to the development of a positive attitude towards the maths lesson, increasing the motivation towards the lesson, and facilitating the student-student and student-teacher communication. As a result, it has been determined that students have positive opinions about the mobile learning environment created by online mathematics lessons.

5 Conclusion and recommendations

In the online mathematics lessons of the students, as in the face-to-face lessons, the students are making an effort to understand mathematics in the online lessons by using mobile learning technologies during the "COVID-19 pandemic process. They stated that they took time to study for the mathematics lesson and they used their study strategies to understand the lesson by using mobile learning technologies. They stated that the materials presented for the mathematics lesson were useful for their learning, and they tried to learn more in mathematics lessons by using mobile learning technologies. In addition to all these, it is easy to follow the mathematics lesson online, but the students who take the lesson stated that they do not always communicate with other students to get help via social media by using mobile learning technologies, they are a little worried about their motivation, about learning the formulas, worrying about failing the mathematics lesson.

Before coming to the university, students stated that their lack of mathematics background prevented them from learning the course, technical problems, pandemic anxiety, inability to adapt to online courses at home, virtual environment problems, and power cuts were other obstacles to learning the course. Despite all these problems, students used appropriate study strategies during the pandemic. It was seen that the students used the strategies of doing a lot of repetition and watching live lesson videos over and over, preparing an individual study program for themselves, taking notes, attending regular classes, and watching educational videos by using mobile learning technologies. Teachers and students should be made aware of the efficient use of mobile technology in education. Studies should be conducted to examine the difficulties faced by teachers and students who teach online mathematics lessons. In their studies, very productive results can be obtained by preparing a suitable lesson plan and making the necessary planning.

Thanks to the widespread use of mobile learning technologies in education, students did not have difficulty in using lecture notes, videos, and course materials related to online education, but still, a significant number of students expressed their concerns about staying in the mathematics course. More detailed research is needed to reveal the difficulty of online mathematics lessons and what other difficulties students in the pandemic process are experiencing and their reasons for concern. To reveal these

difficulties with other research, very productive results can be obtained by taking measures to reduce the difficulties faced by students who use mobile learning technologies in online mathematics courses at the university and reduce their anxiety, and by making the necessary planning.

6 References

[1] Sorooshian, S. (2020). Quarantine decision due to coronavirus pandemic. Electronic Journal of General Medicine, 17(4), em206. https://doi.org/10.29333/ejgm/7862

[2] Cumhur, M. (2020). How can we transfer the math lesson to our children and how can we help them in this difficult process? Retrieved from: http://fenedebiyat.neu.edu.tr/bu-zor-surecte-matematik-dersini-cocuklarimiza-nasil-aktarabilir-onlara-nasil-yardimci-olabiliriz/

[3] Ospanova, B., Aubakirova, R. Z., Kuanysheva, B. T., Kabzhanova, G. A., Anatolyevna, T. I., & Tabakaev, Y. V. (2022). The organization of distance education in during the Covid-19 Pandemic. Cypriot Journal of Educational Science. 17(4): 999-1008. https://doi.org/10.18844/cjes.v17i4.7104

[4] Uşak, M., Sinan, S., & Sinan, O. (2020). New playmaker in science education: COVID-19. Journal of Baltic Science Education, 19(2). https://doi.org/10.33225/jbse/20.19.180

[5] Sahu, P. (2020). Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): Impact on Education and Mental Health of Students and Academic Staff. Cureus 12(4): e7541. https://doi.org/10.7759/cureus.7541

[6] Uşun, S. (2006). Online Education, (S:210-228), Ankara: Nobel Publishing.

[7] Yamamoto, G. T., & Altun, D. (2020). The Coronavirus and the Unavoidable of Online Education rise. Journal of University Studies, 3(1): 25-34. https://doi.org/10.32329/uad.711110

[8] Fauzan, F., Arifin, F., Lubis, M. A., & Firdaus, F. M., (2022). Lecturer's digital literacy ability in the pandemic. Cypriot Journal of Educational Science. 17(4): 1130-1142. https://doi.org/10.18844/cjes.v17i4.7122

[9] Regier, D. S., Smith, W. E., & Byers, H. M. (2020). Medical genetics education in the midst of the COVID-19 pandemic: Shared resources. American Journal of Medical Genetics, 1-7. https://doi.org/10.1002/ajmg.a.61595

[10] Çavuş, N., & Uzunboylu, H. (2009). Improving critical thinking skills in mobile learning. Procedia-Social and Behavioral Sciences, 1(1): 434-438. https://doi.org/10.1016/j.sbspro.2009.01.078

[11] Keskin, N. Ö. (2010). Mobile Learning Technologies and Tools. Retrieved from: https://ab.org.tr/ab10/kitap/_AB10_ikincicilt_tekli.pdf#page=111

[12] Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2012). Scientific Research Methods. Ankara: Pegem Academy.

[13] Tashakkori, A., & Creswell, J. W. (2007). The new era of mixed methods. Journal of mixed methods research, 1(1): 3-7. https://doi.org/10.1177/2345678906293042

[14] Başar, M., Arslan, S., Günsel, E., & Akpınar, M. (2019). Distance Education Perceptions of Prospective Teachers. Journal of Multidisciplinary Studies in Education, 3(2): 14-22. Retrieved from: https://dergipark.org.tr/tr/download/article-file/710027

[15] Bayram, M., Peker, A.T., Aka, S.T., & Vural, M., (2019). Investigation of University Students' Attitudes Towards Distance Education Course. Gaziantep University Journal of Sport Sciences, 4(3): 330-345. https://doi.org/10.31680/gaunjss.586113

[16] Genç, M. F., & Gümrükçüoğlu, S. (2020). The Views of Theology Faculty Students on Distance Education in the Coronavirus (Covid-19) Process. Turkish Studies, 15(4): 403-422. http://dx.doi.org/10.7827/TurkishStudies.43798

[17] Karatepe, F., Küçükgençay, N., & Peker, B. (2020). How do prospective teachers view synchronous distance education? A survey study. Journal of Social and Humanities Sciences Research, 7(53), 1262-1274. http://dx.doi.org/10.26450/jshsr.1868

[18] Karakuş, N., Ucuzsatar, N., Karacaoğlu, M. Ö., Esendemir, N., & Bayraktar, D. (2020). Turkish teacher candidates' views on distance education. Rumeli DE Journal of Language and Literature Studies, (19): 220-241. https://doi.org/10.29000/rumelide.752297

[19] Cumhur, M., & Tezer, M. (2019). Anxiety about mathematics among university students: A multi-dimensional study in the 21st century. Cypriot Journal of Educational Science. 14(2): 222-231. https://doi.org/10.18844/cjes.v14i2.4217

[20] Öztürk, L. (2005). Digital inequality in Turkey: An evaluation on Tübitak-bilten surveys. Journal of Erciyes University Faculty of Economics and Administrative Sciences, 24, 111-131. Retrieved from: http://iibf.erciyes.edu.tr/dergi/sayi24/lozturk.pdf

[21] Korucu, A. T., & Biçer, H. (2019). Mobile Learning: A Content Analysis of 2010-2017 Studies. Trakya Journal of Education, 9(1): 32-43. https://doi.org/10.24315/tred.516911

[22] Koparan, T., & Yılamz, G. K. (2020). Opinions of Mathematics Teacher Candidates on the Learning Environment Supported by Mobile Learning Year 2020. Journal of Uludağ University Education Faculty, 33(1): 109–128. https://doi.org/10.19171/uefad.554184

[23] K. Khairiah, Z. Mubaraq, A. Asmendri, S. Hendriani, D. T. Musa, and A. A. Sihombing, (2022). "Delegitimization of leadership in overcoming difficulties in online learning during the COVID-19 pandemic", World Journal on Educational Technology: Current Issues, vol. 14, no. 3, pp. 726–739. https://doi.org/10.18844/wjet.v14i3.7209

7 Authors

Murat Tezer is a member of the Cyprus Educational Sciences Association, Nicosia, Northern Cyprus. He often works as a reviewer and guest editor for different educational journals, Also he published more than a hundred articles and so many book chapters and received more than a thousand citations (email: murat.tezer@neu.edu.tr).

Meryem Gülyaz is a High School teacher at Ministry of Education and Culture of Turkish republic of Northern Cyprus (email: meryemcumhur1983@gmail.com).

Article submitted 2022-09-12. Resubmitted 2022-10-27. Final acceptance 2022-10-30. Final version published as submitted by the authors.

Determination of Mobile Technology Use in an Interactive Distance Education Classroom Environment

https://doi.org/10.3991/ijim.v16i23.36225

Saule B. Begaliyeva[1(✉)], Bakhytzhan Ospanova[2], Akmaral Magauova[3], Raissa Koshkimbayeva[4], Tina Manyapova[5], Rakhila Zh Aubakirova[6]
[1] Abai University, Almaty, Kazakhstan
[2] Toraighyrov University, Pavlodar, Kazakhstan
[3] Al-Farabi Kazakh National University, Almaty, Kazakhstan
[4] Pavlodar Pedagogical University, Pavlodar, Kazakhstan
[5]Toraighyrov University, Pavlodar, Kazakhstan
[6] Pavlodar State University named after S. Toraighyrov, Pavlodar, Kazakhstan
sbegalieva@mail.ru

Abstract—The aim of this study is to investigate the determination of university students' use of mobile technology in an interactive distance education classroom environment. The quantitative research method was used in the research. The research was conducted in the fall semester of 2021–2022. A total of 318 university students continuing their education in Kazakhstan voluntarily participated in the research. In the research, a 4-week online training was given to university students. The 'distance education and mobile technology' measurement tool developed by the researchers and compiled by experts in the field was used. The measurement tool was delivered and collected by university students via the online method. The analysis of the data was made by using the SPSS programme, frequency analysis, t-test and analysis of variance (ANOVA) test, and the results were added to the research in the form of tables. According to the results obtained from the research, it has been concluded that while university students' level of knowledge in terms of distance education and mobile technologies is high, the situation of university students not using mobile technologies is quite low, but the rate of using them very often is quite high; and it is used by reflecting on the distance education systems in the course.

Keywords—university students, distance education, mobile technology, interactive education

1 Introduction

Computer and Internet have started to show themselves in every field in distance education. However, different conveniences have come with it in many different areas, and technological products have become widespread and an inseparable part of daily life at the end of a certain period [1]. Cell phones, also called mobile phones, have an important place in the country. It is known that the individual fulfils many needs in this life not only with its communication feature, but also with many innova-

tions it has provided such asimage, sound and Internet [2]. Especially in an environment where students or learners can individualise their learning needs in the areas they want, the individual learning approach is gaining more and more importance [3]. The use of technologies that support this approach provides a personalised learning environment. The fact that devices based on mobile technologies are gradually becoming learning centres for learning purposes reveals the mobile learning applications [4].

It is observed that important developments have been recorded in the mobile field with the ever-renewing and developing technology. Its main developments are the strengthening of laptop and tablet computers, the spread of pocket computers, portable media players and smartphones [5]. It is seen that wireless connection, GPRS connection, Bluetooth and infrared connection possibilities are increasingly used in order to enable mobile devices to connect online by themselves or by using them together. In addition, there are significant developments in technologies for storing and transporting information between mobile devices and transferring them between different formats [6]. In the lifelong learning process, the individual must learn by himself. The individual develops skills to access information in different ways in the learning process [7]. It is seen that technological developments play an important role in this process in order to reach information. By providing a flexible environment for the learner, it enables them to use their time more efficiently [8]. Flexibility will enable those who are physically challenged to be in the same environment, those who want to receive an education in addition to the education they have received and the opportunity to easily benefit from their home or any point they want to connect [9]. The rapid increase in information day by day and the desire to access information whenever and wherever makes it necessary to follow this increase, which has increased the importance of learning technologies.

In the studies, mobile devices have been used in different fields and as an environment where different learning activities are carried out. Mobile technologies have been used for application evaluation or experimentation in fields such as grammar, foreign language education, mathematics, management and computer science to support teaching [10]. Similarly, it is possible to come across applications for different purposes such as sharing course documents, formative assessment, exam, homework submission, research and writing [11]. In the mobile learning model, the interaction between the teacher and the students is created, and it is possible to participate in the teaching from different places, homes and even from different countries. Unlike the traditional learning approach, the student is at the centre of this contemporary organisation [12]. Contrary to the fact that all information is learned during the lesson, regardless of time and place, the student learns the subjects as he wishes and can easily connect with his teacher with the help of technology. Mobile learning can be learned without going to school, spending money and time for transportation [13]. Those who live far from schools have the opportunity to learn without leaving their place for reasons such as work, health and family.

1.1 Related research

In their study, Acheampong et al. [14] aimed to investigate the potentials of using mobile technologies to improve the delivery of academic library services in the distance education environment, and as a result, they reached the conclusion that the use of mobile devices in the university environment has become widespread and that distance education supports this application.

Chiu [15], in his research, aimed to reveal the importance of adopting distance/online learning to help students continue learning during the closure of schools due to the COVID-19 pandemic, and as a result, distance education and digital support strategies better meet the needs of students. It has been concluded that needs are the predictors of participation level and that relationship support is very important.

In their study, Pastirmacıoglu et al. [16] aimed to determine the mobile internet usage levels of special education teachers. They concluded that the mobile Internet acceptance model of the special education teacher candidates is positive and they can easily use it in their daily lives. They also said that special education teacher candidates should combine mobile technologies with their own fields.

When the studies conducted in the related research section are examined, it is seen how important the power of mobile technology and distance education is and that they support students in their fields. It can be said that the same results are expected from this study.

1.2 Purpose of the study

The aim of this study is to determine the mobile technology usage of university students in the interactive distance education classroom environment. In line with the purpose of the study, answers to the following questions were sought in the study:

1. What is the mobile technology performance status of the participants participating in the research?
2. What is the mobile technology satisfaction level of the participants participating in the re-search in general?
3. Is there a difference between the distance education satisfaction levels of the participants participating in the research?
4. Is there a difference between the mobile technologies and performance levels participating in the research?
5. Is there a difference between the levels of following the mobile device and distance education participating in the research?

2 Method

When the method part of the research is handled, it is observed that information about which method is used in the research is provided.

2.1 Research model

The quantitative research method was used in the study; the data collection tool developed by the researchers was applied to university students with the help of an online questionnaire. When we collected data about the quantitative research method from the literature, it was seen that this method brought the results of numerical and statistical data to light. In addition, since this method is based on numbers, the sample representing the event or phenomenon should be determined completely and the right questions should be asked [17].

2.2 Working group/participants

The research was carried out in the fall academic year of 2021–2022. The research consisted of 318 volunteer students studying at universities in Kazakhstan at random. All of these students take their courses by linking distance education and mobile technologies.

Gender. In this section, the class status of the population participating in the research was examined and detailed information is given in Table 1.

Table 1. Distribution of university students by gender

Gender	Male		Female	
	f	*%*	*F*	*%*
Variable	161	50.63	157	49.37

As seen in Table 1, the gender data of the participants in the research are included. In this con-text, it is stated that 50.63% (161 people) are male and 49.37% (157 people) are female university students. In the gender section, the findings reflect the actual gender distribution.

Class. In this section, the class variable conditions of the population participating in the research are examined and detailed information is given in Table 2.

Table 2. Distribution of students participating in the study by class

Class	2.Class		3.Class		4.Class	
	f	*%*	*F*	*%*	*f*	*%*
Variable	107	33.65	110	34.59	101	31.76

As seen in Table 2, 33.65% (107 people) of the university students in the study group consisted of second-year students, 34.59% (110 people) were third-year students and 31.76% (101 people) were fourth-year students. Findings in the grade section reflect the actual distribution.

Does encountering mobile technology in the classroom affect performance positively? The question of whether seeing the primary school students included in the research with mobile technology in the classroom environment affects your performance has been sought and the distribution is given in Table 3.

Table 3. Mobile technologies' performance status

Related question	Yes		No	
	f	*%*	*F*	*%*
Variable	298	93.71	20	6.29

When Table 3 is examined, it can be seen that 93.71% (298 people) answered yes and 6.29% (20 people) answered no, according to the distribution of whether mobile technology positively affects their performance in the classroom environment. It can be said that if it is processed in an environment, a positive result will be obtained.

2.3 Data collection tools

In the data collection tool section, it is seen that, first of all, information will be given about which type of data collection tool will be used in the study. The data collection tool, on the other hand, was prepared by experts in order to increase the mobile technology views of university students on interactive distance education classes, and the unsuitable items were removed from the research and corrected. A personal information form called 'distance education and mobile technology' measurement tool, which was applied to the participants participating in the research and developed by the researchers, was used. The content validity of the developed measurement tool was examined by four experts with professor titles working on distance education systems and mobile technology platforms and unnecessary items were removed from the measurement tool and rearranged.

1. Personal information form (demographic data): In the personal information form, information such as gender, class and mobile technology performance effects are included.
2. Distance education and mobile technology data collection tool: A 5-point Likert type questionnaire was prepared in order to obtain information about university students' views on distance education and mobile technology situations. 24 items of the measurement tool consisting of a total of 26 items were used and 2 items were extracted from the measurement tool, thanks to expert opinion. The opinions of the participants participating in the research were sought from two factorial dimensions, such as 'distance education' and 'mobile technology' of the participants participating in the research. The Cronbach alpha reliability coefficient of the measurement tool as a whole was calculated as 0.95. The measuring tool was in the range of strongly disagree' (1), 'disagree' (2), 'undecided' (3), 'agree' (4) and 'strongly agree' (5). The measurement tool was collected from the people who participated in the research in the form of an online environment with a Google survey.

2.4 Application

Live lessons in the form of interactive distance education consisting of 7 sections in total were arranged for 318 primary school students continuing their education in

Kazakhstan. During the 4-week training, mobile technology courses were given on the increase and determination of students' interactive distance education and mobile technology status, including how to use the combination of distance education, interactive education and professional activity; how to reconcile it with time; what is distance education information adaptation; and so on. After the 4-week education, the interview data collection tool was applied to the students and the data are given in tables in the findings section. The education is arranged on the Google meet, which is preferred by most primary schools, and each section is limited to 50 people, distributed over the weeks, each lesson was taught in 40 minutes, and the participants participating in the research in the form of online education were expected to attend the lesson with video and microphone, thanks to their smart devices. The interview form applied to the students was taken with their families through Google Forms.

2.5 Analysis of the data

The data collected with the online questionnaire were analysed using the SPSS IBM 24.0 programme. Percentage, frequency and descriptive analysis results are given by t-test (independent samples t-test), Kruskal–Wallis H-Test and one-way ANOVA methods. Data on numerical developments were tabulated and interpreted, and whether there was a significant difference between independent variables was tested at the level of α=0.95.

In addition, while the data was being analysed, the information in Table 4 was of assistance.

Among the values in Table 4, the values in the findings section were interpreted and shared in the findings section of the tables.

Table 4. Limitations

Weight	Limits	Choice
1	1.00–1.80	I strongly disagree
2	1.81–2.60	I do not agree
3	2.61–3.40	I'm undecided
4	3.41–4.20	I agree
5	4.21–5.00	Absolutely I agree

3 Findings

In this section, the determination of the professional activity adaptation based on distance education and mobile technology dimensions of the participants participating in the research and the findings related to the findings are included.

3.1 Descriptive statistical findings of the mobile technology satisfaction levels of the participants participating in the research

The descriptive statistics regarding the determination of the mobile technology satisfaction levels of the participants participating in the research are given in Table 5.

Table 5. Descriptive statistical findings of the mobile technology satisfaction levels of the participants of the study

Dimension	Course name	*N*	*M*	*S*
Registration to the System with Mobile Technology	Interactive Distance Education	318	4.20	0.578
Mobile Technologies Technical Support		318	4.17	0.683
Mobile Technologies Evaluation	Interactive Distance Education	318	4.11	0.871

As seen in Table 5, it is seen that there is an average of M= 4.20 according to the status of registration to the system with mobile technology regarding the determination of the satisfaction levels of the participants participating in the research. In addition, it is seen that mobile technologies technical support status is and average of M=4.17 and finally mobile technologies' evaluation score is M=4.11. In light of these findings, it can be said that the participant groups participating in the research have a high level of satisfaction with their mobile technologies, and that the registration, technical support and evaluation dimensions are appropriate.

3.2 T-test analysis findings of the participants' distance education satisfaction levels by gender variable

In order to determine whether there is a significant difference between genders in the distance education satisfaction levels of the participants participating in the research, the relevant data were given to the independent samples t-test findings.

As seen in Table 6, according to the gender variable, the arithmetic mean and standard deviation scores of male students were determined as M=4.12, and the arithmetic mean and standard deviation scores of female students enrolled in the distance education system were determined as M=4.09. From the findings, it can be said that there is no difference between male and female students. In addition, when another finding was examined, the distance education technical support department arithmetic mean and standard deviation scores of male students were M=4.22, and the distance education technical support arithmetic mean and standard deviation scores of female students were determined as M=4.18. From the findings, it can be said that there is no difference between male and female students according to the distance education system technical support department. Finally, in Table 6, the distance education evaluation feature arithmetic mean and standard deviation scores of male students were determined as M=4.28, and the system evaluation arithmetic mean and standard deviation scores of female students as M=4.26. From the findings, it can be

said that there is no difference between male and female students according to the distance education evaluation feature.

Table 6. t-test analysis findings of the participants' distance education satisfaction levels by gender variable

Dimension	Gender	*N*	*M*	SS	SD	*t*	*p*	Explanation
Registration to the distance education system	Male	161	40.12	0.53852	318	.261	.601	$p>0.05$ (difference meaningless)
	Woman	157	4.09	0.58960				
Distance education technical support	Male	161	4.22	0.50835	318	.242	.762	$p>0.05$ (difference meaningless)
	Woman	157	4.18	0.64684				
Distance education evaluation	Male	161	4.28	0.64029	318	.268	.742	$p>0.05$ (difference meaningless)
	Woman	157	4.26	0.61052				

3.3 T-test analysis findings of mobile technologies and performance levels participating in the research

In this part, the data related to the independent samples t-test findings applied to determine whether there is a difference between the mobile technologies participating in the research and the t-test analysis findings of the performance levels of the university students according to the mobile technologies variable are given.

As seen in Table 7, the arithmetic mean and standard deviation scores of the students who answered yes according to the mobile technologies variable were determined as M= 4.22, and the arithmetic mean and standard deviation scores of the students who answered no according to the mobile technologies variable were determined as M=2.80. From the findings, it can be said that there is a significant difference between the students according to the mobile technologies variable. In addition, as seen in Table 7, the arithmetic mean and standard deviation scores of the students who answered yes according to the mobile technology performance variable were determined as M= 4.28, and the arithmetic mean and standard deviation scores of the students who answered no according to the learning variable were determined as M= 2.42. Based on Table 7, it can be said that there is a significant difference when both dimensions are considered from the findings.

Table 7. *t*-test analysis results of mobile technologies and performance levels participating in the research

Dimension	Criterion	*N*	*M*	SS	SD	*t*	*p*	Explanation
Mobile technologies	Yes	311	4.22	0.5624	318	−5.49	0.000	$p<0.05$ (significant difference)
	No	7	2.80	0.2684				
Mobile technology performance	Yes	311	4.28	0.57161	318	−8.31	0.000	$p<0.05$ (significant difference)
	No	7	2.42	0.2735				

3.4 One-way ANOVA results of mobile device and distance education tracking levels participating in the research

In order to determine whether there is a difference according to the level of following mobile devices and media technologies of primary school students, data on values of one-way ANOVA results are given.

As seen in Table 8, it is seen that there is a statistically significant difference between the mobile device tracking levels of the participants participating in the research and their 'mobile device' tracking views. According to the findings, it can be said that the mobile device tracking dimension of the students is more effective than their performance. Finally, Table 8 shows that there is a statistically significant difference between the participant groups participating in the research according to their views on following 'distance education technologies'. According to the findings, it can be said that the follow-up dimension of the distance education technologies of the participants participating in the research is effective.

Table 8. One-way ANOVA of primary school students' levels of following mobile devices and media technologies

Dimension	Source of variance	Sum of squares	SD	Average of squares	*F*	*p*	Description
Mobile device	Intergroup	8.788	3	3.300	8.192	0.000	$p<0.05$ (significant difference)
	In groups	38.689	315	0.359			
	Total	47.477	318				
Distance education technologies	Intergroup	17.109	3	6.036	18.57	0.000	$p<0.05$ (significant difference)
	In-groups	33.367	315	0.308			
	Total	50.476	318				

4 Discussion

Sumadi et al. [18] aimed to examine the literature on the analysis of learning opportunities in the pandemic period regarding the effectiveness of online learning, and as a result, they concluded that distance education is the most preferred and used method because it is more practical and easy to use and parents can control the learning process. When this value is combined with the results of the research, it is seen that the students participating in the research have high-performance levels against distance education. In this context, it can be said that the power and importance of distance education is understood during the pandemic period and the values are high.

Kim et al. [19] aimed to provide a clear idea about the determining factors that increase students' intention to use online learning systems (based on an integrated technology acceptance model and theory of planned behaviour) and to provide the moderator role of innovation as an important factor, and as a result, it is seen that they play a regulatory role in the relationship between innovativeness, subjective norms and behavioural intention, and that mobile technology contributes to the students entering this field. The results that they followed regularly were reached.

Xue et al. [20] aimed to investigate the action of online education and also aimed to target that online education includes policy development, education informatics policy, online education system and online education mechanism in China, especially during the epidemic, and as a result, simultaneously they stated in their research that they found classroom-based teaching mode, asyn-chronous enrollment and broadcast teaching mode, online flipped classroom teaching mode and online course-based teaching useful. It is seen that they achieved the results.

In this context, it can be said, based on the researches that distance education with mobile technology has a meaning and that education becomes more enjoyable with distance education. It is among the expectations that this research sheds light on other researches.

5 Conclusion

When the results part of the research is considered, it is seen that the number of participants comes first; the number of participants in the research is always important for a research. Another result of the research is that the participant groups included in the study answered yes to the distribution of whether mobile technology positively affects their performance in the classroom environment. In this context, it is important for the research that they want to see mobile technologies in education.

When another value of the research is considered, it is seen that the status of registration to the system with mobile technology regarding determining the satisfaction levels of mobile technologies of the participant groups participating in the research is high; the technical support status of mobile technologies is high; and the registration, technical support and evaluation dimensions are appropriate. Another value is whether there is a significant difference between the genders of the participants in the distance education satisfaction level of the participants and it was concluded that there was no significant difference between both male and female participants. Among the final values of the study, it was concluded that the arithmetic mean and standard deviation scores of the students who answered yes according to the mobile technologies variable were higher; the arithmetic mean and standard deviation scores of the students who answered no according to the mobile technologies variable were lower. In addition, considering that the same situation is valid in the performance value, it can be said that there is a significant difference and reached when both dimensions are considered from the findings obtained.

When the final result of the research is considered, it is seen that there is a statistically significant difference between the mobile device tracking levels of the participants participating in the research and their ‘mobile device tracking’ views. According to the findings, it can be said that the mobile device tracking dimension of the students is more effective than their performance. Finally, it is seen that there is a statistically significant difference between the participant groups participating in the research according to their views on following ‘distance education technologies’. According to the findings, it can be said that the follow-up dimension of the distance education technologies of the participants participating in the research is effective.

6 References

[1] Batilantes, S. (2022). Unleash the untaught mathematics competencies through online, shareable and offline video lectures. *International Journal of Learning and Teaching, 14*(2), 70–85. https://doi.org/10.18844/ijlt.v14i2.6624

[2] Harangus, K. (2021). Assessing competence in teacher education: Development of university students' problem-solving skills. *International Journal of Innovative Research in Education, 8*(2), 102–110. https://doi.org/10.18844/ijire.v8i2.6806

[3] Hafeez, M. (2022). Effects of game-based learning in comparison to traditional learning to provide an effective learning environment—A comparative review. *Contemporary Educational Researches Journal, 12*(2), 89–105. https://doi.org/10.18844/cerj.v12i2.6374

[4] Antropova, M. Y., Vlasov, A. A., & Kasyanenko, E. F. (2019). Mobile technologies in educational process Chinese universities. *New Trends and Issues Proceedings on Humanities and Social Sciences, 6*(5), 1–7. https://doi.org/10.18844/prosoc.v6i5.4367

[5] Jamaris, Hidayat, H., & Muji, A. P. (2021). Mobile Learning Application: Effect of Learning Readiness and Community Learning Toward Technology Management and Mobile Learning. *International Journal of Online and Biomedical Engineering (iJOE), 17*(13), pp. 20–32. https://doi.org/10.3991/ijoe.v17i13.26871

[6] Högberg, K. (2022). Learning to Lead from a Distance: Reflexive Learning during a Pandemic. *International Journal of Advanced Corporate Learning (iJAC), 15*(1), pp. 6–19. https://doi.org/10.3991/ijac.v15i1.27643

[7] Suartama, I. K., Setyosari, P., Sulthoni, S., & Ulfa, S. (2019). Development of an Instructional Design Model for Mobile Blended Learning in Higher Education. *International Journal of Emerging Technologies in Learning (iJET), 14*(16), pp. 4–22. https://doi.org/10.3991/ijet.v14i16.10633

[8] Lai, Y., Saab, N., & Admiraal, W. (2022). University students' use of mobile technology in self-directed language learning: Using the integrative model of behavior prediction. *Computers & Education, 179,* 104413. https://doi.org/10.1016/j.compedu.2021.104413

[9] Wang, J., Tigelaar, D. E., & Admiraal, W. (2019). Connecting rural schools to quality education: Rural teachers' use of digital educational resources. *Computers in Human Behavior, 101,* 68-76. https://doi.org/10.1016/j.chb.2019.07.009

[10] Szopiński, T., & Bachnik, K. (2022). Student evaluation of online learning during the COVID-19 pandemic. *Technological Forecasting and Social Change, 174,* 121203. https://doi.org/10.1016/j.techfore.2021.121203

[11] Ishtiaq Khan, R. M., Ali, A., Alourani, A., Kumar, T., & Shahbaz, M. (2022). An Investigation of the Educational Challenges during COVID-19: A Case Study of Saudi Students' Experience. European Journal of Educational Research, 11(1), 353-363. https://doi.org/10.12973/eu-jer.11.1.353

[12] Ulum, H. (2022). The effects of online education on academic success: A meta-analysis study. Education and Information Technologies, 27(1), 429-450. https://doi.org/10.1007/s10639-021-10740-8.

[13] Jayakumar, P., Suman Rajest, S., & Aravind, B. R. (2022). An Empirical Study on the Effectiveness of Online Teaching and Learning Outcomes with Regard to LSRW Skills in COVID-19 Pandemic. In Technologies, Artificial Intelligence and the Future of Learning Post-COVID-19 (pp. 483-499). Springer, Cham. https://doi.org/10.1007/978-3-030-93921-2_27

[14] Acheampong, E., & Agyemang, F. G. (2021). Enhancing academic library services provision in the distance learning environment with mobile technologies. The *Journal of Academic Librarianship, 47*(1), 102279. https://doi.org/10.1016/j.acalib.2020.102279

[15] Chiu, T. K. (2022). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education, 54*(sup1), S14-S30. https://doi.org/10.1080/15391523.2021.1891998

[16] Pastırmacıoglu, B., Caliskan, S., Ozcan, D., & Uzunboylu, H. (2018). Determining a Mobile Internet Acceptance Model of Special Education Teacher Candidates. *International Journal of Interactive Mobile Technologies (iJIM), 12*(4), 32-42. https://doi.org/10.3991/ijim.v12i4.9198

[17] Nurbol, U., Shakhislam, L., Kulyash, K., Bakhadurkhan, A., Sholpan, K. & Kairat, Z. (2022). Evaluation of students' views on teaching the subject of migration through distance education in Kazakhstan geography course. *World Journal on Educational Technology: Current Issues, 14*(1), 294–305. https://doi.org/10.18844/wjet.v14i1.6260

[18] Sumadi, C. D., Hidayat, A., & Agustina, I. (2022). Literature Study: Analysis of Learning Facilities in the Pandemic Era on the Effectiveness of Online Learning in Elementary School. Widyagogik: *Jurnal Pendidikan dan Pembelajaran Sekolah Dasar, 9*(2), 183-190.https://doi.org/10.21107/widyagogik.v9i2.13808

[19] Kim, E. J., Kim, J. J., & Han, S. H. (2021). Understanding student acceptance of online learning systems in higher education: Application of social psychology theories with consideration of user innovativeness. *Sustainability, 13*(2), 896. https://doi.org/10.3390/su13020896

[20] Xue, E., Li, J., & Xu, L. (2022). Online education action for defeating COVID-19 in China: An analysis of the system, mechanism and mode. *Educational Philosophy and Theory, 54*(6), 799-811. https://doi.org/10.1080/00131857.2020.1821188

7 Authors

Saule B. Begaliyeva is a Professor and Doctor in Pedagogical Sciences at Abai University, Almaty, Kazakhstan (email: sbegalieva@mail.ru).

Bakhytzhan Ospanova is a doctoral student in 'Pedagogy and psychology' at Toraighyrov University, Chokin Street 29/1, Pavlodar city, Kazakhstan (email: ospanova-22@mail.ru).

Akmaral Magauova is a Professor and Doctor in Pedagogical Sciences at Al-Farabi Kazakh National University, Almaty, Kazakhstan (email: agauova@mail.ru).

Raissa Koshkimbayeva is a Senior Lecturer and Master in Pedagogical Sciences at NJSC 'Pavlodar Pedagogical University', Pavlodar, Kazakhstan (email: raissa-1964@mail.ru).

Tina Manyapova is an Associate Professor and Candidate of Philological Sciences at Toraighyrov University, R. Luxemburg str. 102, Pavlodar, Kazakhstan (email: manyap23@mail.ru).

Rakhila Zh Aubakirova is a Professor and Doctor in Pedagogical Sciences at Toraighyrov University, Lomova Street 64, Pavlodar, Kazakhstan (email: kama_0168@mail.ru).

Article submitted 2022-07-07. Resubmitted 2022-08-24. Final acceptance 2022-08-27. Final version published as submitted by the authors.

Determining University Students' Views on Mobile Technology and Moodle Applications in Personalized Learning

https://doi.org/10.3991/ijim.v16i23.36207

Zhanat Seitakhmetova[1(✉)], Utebayeva Aliya Tulkibaevna[2], Aigul Sadvakassova[3], Akerke Ikenova[4], Raigul Karmenova[5], Gulnur Zhunussova[4]
[1] East Kazakhstan Technical University, Ust-Kamenogorsk, Kazakhstan
[2] Shymkent University, Shymkent, Kazakhstan
[3] L.N.Gumilyov Eurasian National University, Astana, Kazakhstan
[4] Sarsen Amanzholov East Kazakhstan University, Ust-Kamenogorsk, Kazakhstan
[5] International school of Nur-Sultan, Astana, Kazakhstan
zhanat.seitahmetova@mail.ru

Abstract—The aim of this study is to determine the opinions of university students about mobile technology and Moodle applications, considering that university students continue their lessons through the distance education platform throughout the pandemic, mobile technology will turn into an advantage for them. Quantitative research method was used in the study. The research was conducted in the fall semester of 2021-2022. 270 volunteer university students that study in Kazakhstan participated in the research. In the research, 3-week online training was given to university students. In the research, the "Moodle & Mobile Technology" measurement tool developed by the researchers and compiled by experts in the field was used. The measurement tool was delivered and collected by university students via online method. The analysis of the data was made using the SPSS program, frequency analysis, t-test and anova test, and the results were added to the research with tables and comments. According to the results obtained from the research, it has been concluded that university students have a high opinion of mobile technology and module application.

Keywords—Moodle, mobile technology, personalized learning, distance learning platforms, university students

1 Introduction

It is known that the Covid-19 epidemic, which is accepted as a pandemic all over the world in today's conditions, deeply affects education and training activities, as it does in many areas [1]. With the effect of this situation, it is seen that formal education is suspended in schools and universities in our country and all over the world, and compulsory distance education is started [2]. Many students and teachers around the world have had to stay at home like other members of society. It is seen that the necessity of this transformation to be very fast at all levels of education complicates

the process [3]. The distance education approach, which was previously known to be more suitable for mobile technology education for university students, had to be implemented at all levels of education due to the epidemic, which is likely to last for a long time. [4]. It is known that even the institutions of different schools with online education and distance education experience face different difficulties in conducting their current academic activities remotely in a short time compared to university terms [5]. Two important difficulties experienced in higher education institutions in the transition to compulsory distance education in a short time were the need to quickly provide the necessary technological infrastructure for these applications and to increase the technical and pedagogical competencies of the users in these technologies. distance education in a short time [6]. It is foreseen that all teaching activities will be carried out over the internet with asynchronous and synchronous tools, but this has brought unexpected loads to the existing information infrastructures of higher education institutions [7]. It has been difficult to increase the capacities in technical infrastructures due to the inability to provide adequate supply for the rapidly increasing demand, unexpected costs, lack of experts and the uncertainty of the pandemic process. On the other hand, technology literacy of all higher education members, especially students and lecturers for general and distance education, had to be minimized in a short time [8]. Trainers with different experiences and attitudes in information and communication technologies have had to take fast, intensive and mostly online in-service seminars due to the pandemic. Especially in the spring of 2020, when the effects of the pandemic emerged, many faculties and students had to do many activities through distance education for the first time: digitizing and sharing course materials, synchronized processing of lectures over the Internet, online exams, etc. The difficulties, effects and solutions experienced in the transition to compulsory distance education and its implementation have been experienced at different levels in different universities [9].

The fact that distance education can be done easily with technological developments has led institutions and companies to conduct their education in this way. Online learning systems serve companies and institutions. It is known that systems such as Moodle, Blackboard and other learning management systems are used as instructional management systems used in this field [10]. Especially open source Moodle is a popular teaching management system used by universities. These instructional management systems have developed versions suitable for mobile use with the increasing use of mobile platforms [2]. In addition, with the updated version of Moodle's mobile application, mobile devices that provide easy access to students and the Internet become the first choice for accessing the Internet. Being always open and always with people puts this platform first in internet access [11]. While the developments in the mobile internet infrastructure of operator companies accelerate the use of mobile internet, the number of people using mobile internet is also increasing. As the capabilities and capabilities of mobile systems evolve in line with technological developments, more media can be viewed, played, and code stacks run [12]. This rich content infrastructure enables the development of many different sectors in the mobile field. The internet world, which users now access from mobile, has now had to make

mobile designs. Website designs that adapt and respond to the screen size have taken their place in the internet world [13].

1.1 Related studies

In the study of [14] the study aimed to examine the effect of Moodle, as an academic flow-based learning management system, on the writing skills of English learners, and as a result, they found that the writing skills of the students participating in the study were improved by using Moodle in their online virtual classroom instead of traditional methods. and also stated in their studies that Moodle application is beneficial for students.

It is expressed in the work of [15] within the framework of current trends in Higher Education, particularly the assurance, structuring and development of complete virtual courses on the web without the need for deep computer science knowledge. They aimed to be developed for the various teaching methods and learning trends available under conditions and facilities that allow virtual courses to be electronic, hybrid or mobile, and as a result, in their research they ensured the smooth structure and functioning of undergraduate and postgraduate virtual courses on the Moodle platform, and also while designing teaching activities. and they have reached the conclusion that it is more accurate to combine their digital resources with moodle in order to bring them together and develop them.

[16] are aiming to adapt their work in (2022) to the research facility of the Moodle platform, this year digitalize while designing and assembling their effectiveness and improving them. , research and as a result, working with the system Moodle, Moodle-based English Learning approach and also with the help of Moodle in the package, it is seen that students achieve better learning results in this area.

When the relevant research part is discussed and the articles and researches are examined, it is seen that there are values that the moodle application and mobile technology also positively affect the educational dimension in their lives. In this context, it is thought that the formation of the same values in the participant groups in this study will benefit and benefit the field writing.

1.2 Purpose of the study

In this study, it was aimed to determine the opinions of university students about mobile technology and moodle applications and to seek answers to the following questions regarding the related problem situation and general purpose.

1. How Are the Mobile Technology Usage Times of the Participant Groups Participating in the Study?
2. What is the Level of Knowledge of the Participant Groups Participating in the Study about the Moodle Application?
3. What are the Views of the Mobile Technology Groups of the Participants in the Study?

4. What are the opinions of the Participant Groups participating in the Study about the field of Moodle Application?
5. Is There a Difference between Moodle and Mobile Technology According to the Gender Criteria of the Participant Groups Participating in the Study?
6. Is There a Difference between Moodle and Mobile Technology According to the Age Criteria of the Participant Groups Participating in the Study?

2 Method

In this part of the research, the method used in the study, which will include the information given and seen in the method section of the researches about the type of data collection tools and the numerical values in the source based on moodle and technology, has been compiled according to the information given. the work has been edited.

2.1 Research methods

It is seen that research methods are used in the sub-dimensions of the research through the quantitative research model. from previous lifetimes to the present [17]. In this research, in or-der to determine the opinions of university students about mobile technology and moodle applications by using quantitative research method; gender was defined according to the vari-ables of education period.

2.2 Working group/participants

The participation groups included in the research are East Kazakhstan Technical. It is observed that it consists of 270 students continuing their education at the university institution. The measurement tool used in the study was applied to 270 participants with the help of an online questionnaire and accepted.

Gender. In this section, the differences of the university students participating in the research according to their gender are given in Table 1.

Table 1. Distribution of the Participants Participating in the Study according to Gender Variable

Gender	Male		Female	
	F	***%***	***F***	***%***
Variable	136	50.37	134	49.63

When the values on Table 1 of the study were examined, distributions were determined according to the gender variable of the participant groups participating in the study and the in-formation was examined and added to Table 1. In this context, it is seen that 50.37% (136 people) of male participants, while 49.63% (134 people) of female participants. In the gender section, the findings reflect the actual gender distribution.

Mobile technology usage times of the participant groups participating in the study. In this section, the times of using mobile technologies during the day for the audience participating in the research were investigated according to the problem situation of the research, and detailed information is given in Table 2.

Table 2. The Mobile Technology Usage Times of the Participants Participating in the Study During the Day

The use on mobile technology	1-2 Time		3-4 Time		5 and above hours	
	F	***%***	***F***	***%***	***F***	***%***
Variable	17	6.30	52	19.26	201	74.44

When Table 2 is examined, the group surveyed within a day of the days of mobile technology researched and detailed information are given in Table 2 time zones used in this context, Table 2 is examined, %6.30% to (17 people) using mobile technology for 1-2 hours, as they uttered, when %19.26 percent (52 people) they expressed using mobile technology in the range of 3-4 hours, and finally %74.44 percent (201 people) and over 5 hours to use mobile technology became, in this context, it is observed that he prefers using mobile technology in the range of 5 hours and above in the research period of the day December.

The level of knowledge of the groups of participants participating in the research about the Moodle application. In this section, the knowledge levels of the participants who participated in the study about the problem situation of the research about the application of moodle have been investigated and detailed information is given in Table 3.

Table 3. The Level of Knowledge of the Groups of Participants Participating in the Re-search about the Moodle Application

Knowledge Levels of Moodle Application	I have information		I don't know		I have partial knowledge	
	F	***%***	***F***	***%***	***F***	***%***
Variable	63	23.33	159	58.89	48	17.78

When Table 3 is examined, in relation Moodle groups of participants surveyed were investigated and the application of knowledge about a problem state levels are given in Table 3, in this context, when Table 3 is examined, %23.33 percent (63 people) when choosing the option to have knowledge of, %58.89 percent (159 people), I don't have the information option, and finally %17.78 percent (48 people), it is observed that select the option I have information partially, the problem is I don't have the most information about the status of option was selected when the students Moodle, which will be described in this section can be seen.

Age status. In this section, the age status of the study participants was examined, and detailed information was given in Table 4.

Table 4. Distribution of the groups of participants participating in the study according to their Age Status

Age	18-21		22-26		27 and above ages	
	F	***%***	***F***	***%***	***F***	***%***
Variable	176	65.18	73	27.04	21	7.78

When Table 4 is examined, the data on the age status of the participant groups participating in the research were examined and the relevant information according to the age scale was added to the table. Considering the Table 4, 65.18% (176 people) are between the ages of 18-21, 27.04% (73 people) are between the ages of 22-26, and finally 7.78% (21 people) 27 years and over. In the age status section, the findings reflect the true distribution.

2.3 Data collection tools

In the data collection tool section, it is seen that first of all, information will be given about what kind of data collection tool will be used in the research. The data collection tool has been prepared by experts to increase the opinions of university students about mobile technology and moodle applications and the inappropriate substances have been removed from the research and the data has been shaken correctly. A personal information form called the "Moodle and Mobile technology" measurement tool, which was applied to the groups of participants participating in the study and developed by the researchers, was used. The scope validity of the developed measurement tool has been examined by experts with the title of 4 professors working on learning management systems and mobile technology platforms, and unnecessary items have been removed from the measurement tool and rearrangements have been made.

1. Personal Information Form (Demographic Data): In the personal information form; information such as age, gender, mobile technology usage and knowledge levels about moodle are included.
2. Moodle & Mobile Technology Data Collection Tool: In order to get information about the opinions of university students about mobile technology and moodle applications, a 5-point likert type questionnaire was prepared. 22 items of the measurement tool consisting of a total of 25 items were used and 3 items were removed from the measurement tool thanks to the expert opinion. The opinions of the participants participating in the research were ap-plied from two factorial dimensions, such as the situations of the participant groups participating in the study, such as "Moodle Usage" and "Mobile Technology". The Cronbach Alpha reliability coefficient of the measurement tool as a whole was calculated as 0.91. Measurement tool; "strongly disagree" (1), "disagree" (2), "I'm undecided" (3), "agree" (4) and "strongly agree" (5) in the form of rated. The measurement tool Moodle questionnaire was also collected from the people participating in the study in the form of an online environment.

2.4 Application

The uznab prepared according to the application dimensions to determine the views of university students on moodle and mobile technology and applications can be seen. Video conference and Google meet with the program participant groups determined in Kazakhstan to East Kazakhstan Technical University, Kazakhstan region by researchers who continue research, education and research with the help of people. Moodle mobile technology and use cases were determined with the help of live events, live and timely preparation on the course, prepared with the Google Meet video conference application program and this event was organized by showing it to the experts in the field. In the field of educational environment, when the activity part of the research is completed, it is aimed that university students will discover the moodle environment and have a good command of mobile technologies. During the 3-week training, activities related to the live narrations of the participating groups, such as "moodle environment", "mobile technology", etc. The information was transferred to the participants in the research as follows: distance education and participants were expected to participate in this topic every week. After the 3-week training, the data collection tool and the information form were applied to the participant groups through an online questionnaire in moodle, and the data were given in tables in the findings section. Education On most platforms used in the Google video conferencing app Part 2, and each Support distributed through the program will be capped at a maximum of 140 participants in a designated section, so it's set to be distributed in total to each event in the program next week. 45-minute training In the 60-minute 15-minute question-answer period, one of the groups participating in the online training was expected to take images using devices such as tablets, phones, computers and microphones. attend training. The measurement tool applied to the participant groups was collected through an online questionnaire, coded in calculation programs and transferred to the SPSS program.

2.5 Analysis of the data

In the analysis of the data, statistical data obtained from university students were analyzed in the Statistical program using frequency (f), percentage (%), mean (M), standard deviation (SS), t-test, One Way ANOVA with ira. Numerical values are given to the data obtained from the program in tables, accompanied by comments in the findings section.

3 Findings

In this section of the research, the numerical findings obtained as a result of the analysis of the statistical data obtained in the research have been added to this section in the form of tables, and various interpretations have been given in accordance with the findings.

3.1 Mobile technology opinions of the participant groups participating in the research

In this part of the research, the findings related to the mobile technology views of the participant groups are given on Table 5.

Table 5. Mobile Technology Opinions of the Participant Groups Participating in the Research

No	Opinions on Mobile Technology		
		M	***S***
1	I refreshed my knowledge in mobile technology and used mobile technology thanks to innovative training	4.34	0.61
2	Mobile technology has made me understand education better	4.46	0.63
3	Thanks to mobile technology, I understood the lesson better	4.31	0.75
4	It gave me pleasure to use the mobile technology he uses in different places, not in the classroom environment	4.21	0.65
5	Courses given using mobile technology increase the efficiency of students and courses	4.26	0.74
6	The lessons given using mobile technology allow me to express myself more easily	4.34	0.72
7	The use of mobile technology in the lessons increases motivation.	4.36	0.62
8	Mobile technology enables active learning	4.43	0.7
9	The presentations shared in the activities made through mobile technology offer different perspectives to the students	4.34	0.72
10	The questions shared in the activities with mobile technology enable the students to learn the lesson better	4.36	0.69
11	Mobile technology gives students the opportunity to offer richer content	4.26	0.74
General Average		4.33	0.68

When Table 5 is discussed, surveyed participants regarding their opinions of the statistical findings among groups of mobile technology, each answer carries a different meaning after the events of the participating groups, although this area that is high on the basis of the views of Table 5 can be said of the research, from the most obvious expression, "it helped me understand better education, mobile technology," *M*=4.46 finding was reached. In addition, it was found that one of the most obvious statements of the research is "I refreshed my knowledge in mobile technology and used mobile technology thanks to innovative education" *M*=4.34. It is seen that the views of participants surveyed groups of mobile technology is quite high, while other findings "courses using mobile technology allows you to easily ex-press myself more" *M*=4.34 finding was reached. Another finding of the research is that "Mo-bile technology provides active learning" It was found that *M*=4.43, finally, it is seen that the general average is found to be *M* = 4.33.

When examining the future of mobile technologies in the lives of the group of study participants Table 5 that you can use very easily and also, they can reach where you want it actively in their learning, they provide mobile technology, mobile technology, mobile technology that they found the courses they express themselves better among the findings are simple and useful. In this context, it can be said based on the

findings that mobile technology is positive for the participant groups because all the values in Table 5 have a positive meaning.

3.2 Opinions of the groups of participants participating in the research on the field of Moodle application

In this part of the study, the findings regarding the moodle application of the participant groups participating in the study are given on Table 6.

Table 6. Opinions of the Groups of Participants Participating in the Research on the field of Moodle Application

No	Opinions on Moodle Application		
		M	***S***
1	The lessons I took with the Moodle application provided more lasting learning compared to the traditional classroom environment	4.34	0.65
2	The lessons I have taken on the Moodle application increase my interest in the lesson	4.41	0.63
3	I believe that the lessons given using the Moodle application increase success	4.41	0.63
4	It is more interesting to create activities in the lessons given using Moodle	4.34	0.69
5	Lessons taught using Moodle become more effective in collaborative learning	4.39	0.66
6	Lessons taught using Moodle increase the efficiency of students and courses	4.34	0.61
7	The lessons given using Moodle allow me to express myself more comfortably	4.36	0.73
8	The use of Moodle in lessons positively affects my motivation	4.34	0.65
9	The Moodle app enables active learning	4.41	0.63
10	The presentations shared in the activities made through Moodle offer different perspectives to the students	4.29	0.74
11	I believe that the questions shared in the activities with Moodle enable students to learn the lesson better	4.36	0.62
	Overall Average	4.36	0.65

Table 6 statistical research participants in relation to moodle on the application when examining the findings are among the groups participating in the each answer carries a different meaning, although after the events of Moodle that are high regarding the field of application on the basis of the views of Table 6 can be said of the research, from the most obvious ex-pression, "the lessons I learned on the course Moodle increases my interest in the app," and "using Moodle courses to help promote the success of I believe in the" M=4.41 finding was reached. In addition, it was found that one of the most obvious expressions of the research is "The lessons given using Moodle allow me to express myself more comfortably" M=4.36. Another finding of the research "Moodle learning environment compared to traditional class-room courses I took with the more permanent the app is provided" M=4.34, and "I believe that students learn better questions shared in the lesson activities with Moodle" M=4.36 finding was reached. In addition, another value of the research is that "presentations shared in activities through Moodle offer different perspectives to students" It was found that M=4.29, final-ly, it is seen that the overall average is found to be M = 4.36.

Table 6 shows that the groups of participants were able to follow the lessons related to the problem situation of the research using the moodle application, that they were able to do active learning with the moodle application, that their motivation increased by using the moodle application, that they enjoyed the activities given with the moodle application and that they received and reached a lot of positive information. In this context, it can be said based on the findings that all the values in Table 6 are useful in the field of moodle application of participant groups, as they have a positive meaning.

3.3 The Moodle and mobile technology status of the participant groups participating in the study according to gender criteria

In this section of the research, the moodle and mobile technology situations of the participant groups were examined according to the gender variable and whether there is a significant difference is given in Table 7.

Table 7. Technology Status of Participant Groups According to Gender Criteria

	Gender	**N**	***M***	**SD**	**Df**	**t**	**p**
Moodle and Mobile Technology Cases	Male	136	4.38	0.47	270	-523	.500
	Female	134	4.35	0.44			

When Table 7 was examined, the mobile technology and moodle situations of the participant groups were examined according to the gender variable and it was found that there was no significant difference according to the gender criterion. [t(270)= -523, p<.05]. When the mobile technology and moodle situations of the participant groups are examined, it is seen that the average score of the male participant groups in this area is (*M*=4.38), while the average score of the female participants in this area is (*M*=4.35). In this context, it can be said that there is no difference between the mobile technology and moodle scores of male participants compared to female participants in this study, the findings of the study can also be said Decisively.

3.4 The Moodle and mobile technology status of the participant groups participating in the study according to the age criterion

In this part of the study, it is seen that the One Way ANOVA findings were presented to the participant groups in order to determine the values of determining the moodle and mobile technology status according to the age criterion.

As can be seen in Table 8, there was no significant difference between the results of the comparison of the moodle and mobile technology status of university students for the age criterion. Dec. (χ2 (3)= 1.882; P=.135; P>0.05). Age of college students Moodle mobile technology and the criteria for judging the results of the comparison of the situations the highest value between the ages of 18-26 21yas than the lowest value in the range are in the range of age and above, and these values did not show a significant difference in the highest and lastly it can be said that the age range.

Table 8. Moodle and Mobile Technology Status of the Participant Groups Participating in the Study According to Age Criteria

Age	N	Rank Average	SD	X^2	P
18-21	176	38.5	3	1.882	.135
22-25	73	29.1			
26 and over	21	22.5			

4 Discussion

In 2021, [18] worked on the student's attendance, behavior and personality prediction model by offering students to Moodle log data to investigate the impact of factors impact the performance and sought to use, and as a result his or her contribution and to propose a framework for an intelligent learning environment moodle to work with the performance of the environment is symmetric, because it is seen that the statistics and the results of their own values reach compliant, when the result of the research is combined with this value, it is seen that the values of university students re-garding the moodle application are in a positive direction, in this context, it can be said that these technologies provide positive benefits to people receiving education.

The main purpose of [19] were to examine the relationship between language by Deciphering, improve the graphics of teachers 'self-efficacy and mobile education is aimed at studying, and as a result the level of self-efficacy of mobile technology and the level of training of Language teachers attitude I can do less unstable' they achieved in this context, the results of this research, when combined with the values the use of mobile technology in research, it is observed that the results they provide active learning is reached in, in this context, it can be said that the values of the studies carried out with mobile technology differ according to the time and place and the participant groups.

The work by [20], in the purpose of this article, is aimed at providing a description of various approaches to adaptive learning, and as a result, in the system Moodle e-learning courses, as well as Polish and Ukrainian students by using the Google Suite for Ms teams conducted for students in synchronous and asynchronous modes of the results arrived at, and also achieved the lessons they provide the benefits of this technology, in this context, when this value is combined with the values of the research, it is seen that the audience in the study is trained with google meet technology, and it is concluded that moodle applications benefit their courses synchronously within the system they use, it can be said that they benefit students in both values in this context.

Research carefully examined, and a common set of mobile technology to stay a step ahead of Moodle has been made in the education of students shows that, in this context, this re-search is of significant value in shedding light to this study there is no connection between the expectations of students, it can be argued as important for educators to always be one step ahead.

5 Conclusion

If the results of the research are taken into account, it is seen that the number of participants came first, in this context, as a result, it is seen that 270 people participated in this re-search, with another change, the excess of these people will benefit and benefit in the field summer. Another Value Study Group of the research participant within a day of time zones used in the days of mobile technology, researched, and as a result the range up to 5 hours and the above results have been achieved in the use of mobile technology, thus the problem is reached, it is observed that the results would be made a step forward. Another value of the research is that it has been investigated whether there are information levels about moodle application regarding the purpose of the research and it seems that it has been concluded that there are no information levels, an explanation of this value has been provided in the application environment and is given in other tables.

Another important result of the study of mobile technology researched opinions regarding their opinions of the participating groups participating in the survey, and as a result, participant of the groups that can use mobile technology mobile technologies in future lives, they can also very easily reach where you want and they provide actively in their learning, mobile technology, mobile technology courses they express themselves better in the simple, convenient and they found the results have been achieved. If research participants in relation to an-other value the opinions of Moodle implementation of research, researched, and as a result, the state dismissed the application to the research problem of the participating groups, they were able to follow the lessons using Moodle, moodle with the application of active learning that they are capable of, there's more of motivation by using the application, moodle, moodle is provided with the application knowledge and the activities that they enjoy and their many positive conclusions are reached, it is seen that take place. Another value of the research is that the mobile technology and moodle situations of the participant groups were examined according to the gender variable and it is seen that there is no significant difference according to the gender criterion, and it is also seen that the results of both gender values are high. The final value of the research is that it seems that there is no significant difference between the results of the comparison of the moodle and mobile technology situations of university students for the age criterion.

According to the results obtained as a result of the research, it was concluded that university students have a high opinion of mobile technology and moodle application.

6 References

[1] AL-Momani, M. O., & Jawarneh, R. S. (2022). Occupational satisfaction of physical education teachers in Jordan. International Journal of Innovative Research in Education, 9(1), 74–89. https://doi.org/10.18844/ijire.v9i1.7531

[2] Cavus, N., & Sekyere-Asiedu, D. (2021). A comparison of online video conference platforms: Their contributions to education during COVID-19 pandemic. World Journal on Educational Technology: Current Issues, 13(4), 1162-1173. https://doi.org/10.18844/wjet.v13i4.6329

[3] Miah, M. R., Rahman, A. A. M. S., Sayok, A. K., Samdany, A. A., & Hannan, M. A. (2021). How to fight the COVID-19 global crisis. World Journal of Environmental Research, 11(2), 31–38. https://doi.org/10.18844/wjer.v11i2.5855

[4] Gipal, R. J. D., Carrillo, L. J., & Mallonga, J. C. (2022). Teachers' experiences of online teaching in English as a second language classes during the COVID-19 pandemic. International Journal of Learning and Teaching, 14(4), 97–111. https://doi.org/10.18844/ijlt.v14i4.6758

[5] Gurban, S., Zhiembaev, A., & Zeybel, V. (2022). Popularization of physical activity in rural schools of Kazakhstan's Aktobe region. New Trends and Issues Proceedings on Humanities and Social Sciences, 9(1), 31–42. https://doi.org/10.18844/prosoc.v9i1.7093

[6] Güner, A., & Gurbuz, H. (2022). A confirmatory factor analysis of university students' high-context and low-context communication. Global Journal of Sociology: Current Issues, 12(1), 84–94. https://doi.org/10.18844/gjs.v12i1.7889

[7] Albandary Alamer, Noura Alaskar, Sana Bukhamseen, Jawaher Alkhamis, Enas Alghamdi, & Almaha Almulhim. (2022). Design and prototyping of Kiddo, a mobile application for parents to control kids' learning. Global Journal of Information Technology: Emerging Technologies, 12(1), 59–68. https://doi.org/10.18844/gjit.v12i1.7432

[8] Matei, E. F., & Mindrican, I. M. (2022). Impact of the COVID-19 pandemic on labor market mobility and fiscal-budgetary measures implemented. Global Journal of Business, Economics and Management: Current Issues, 12(2), 153–167. https://doi.org/10.18844/gjbem.v12i2.6161

[9] Uzunboylu, H., Prevalle Ethemi, B., & Hamidi, M. (2021). Análisis de contenido de trabajos de investigación sobre aprendizaje invertido. Revista de Educación a Distancia (RED), 21(66). https://doi.org/10.6018/red.451551

[10] Gamage, S. H., Ayres, J. R., & Behrend, M. B. (2022). A systematic review on trends in using Moodle for teaching and learning. International Journal of STEM Education, 9(1), 1-24. https://doi.org/10.1186/s40594-021-00323-x

[11] Qushem, U. B., Christopoulos, A., Oyelere, S. S., Ogata, H., & Laakso, M. J. (2021). Multimodal technologies in precision education: providing new opportunities or adding more challenges?. Education Sciences, 11(7), 338. https://doi.org/10.3390/educsci11070338

[12] Gençoğlu, S., & Bilgilİ, M. S. (2021). Management of liquid digestate in biogas plants. New Trends and Issues Proceedings on Advances in Pure and Applied Sciences, (14), 51–62. Retrieved from https://un-pub.eu/ojs/index.php/paas/article/view/6795

[13] Hnezdilova, K., & Barjadze, R. (2022). Opportunities of a personal learning environment for performing self-education activities of the future pharmacy employee. ScienceRise: Pedagogical Education, (4(49), 17–23. https://doi.org/10.15587/2519-4984.2022.261052

[14] Fatimah, S. & M. (2022). Moodle Integration Intervention in EFL Virtual Classroom and Academic Flow on University Students' Achievement in Writing. Theory and Practice in Language Studies, 12(10), 2182-2190. https://doi.org/10.17507/tpls.1210.26

[15] Peña Cruz, Y., & De la Peña Consuegra, G. (2022). Analysis of Indicators for the Proper Development of Virtual Courses on the Moodle Platform. In Technology-Enabled Innovations in Education (pp. 619-629). Springer, Singapore. https://doi.org/10.1007/978-981-19-3383-7_51

[16] Prasetya, R. E., & Nugraha, N. A. S. (2022). English Educational Moodle-Based Environment on Actualizing Personalization Virtual Course. Premise: Journal of English Education and Applied Linguistics, 11(2), 365-385. https://doi.org/10.24127/pj.v11i2.4911

[17] Caliskan, S., Shukshina, L. V., Niyazova, A. Y., Kulakova, N. N., Ishmuradova, A. M., & Kunitsyna, M. L. (2022). Investigation of Mechanical Engineering Academicians' Use of

Distance Education Technologies. International Journal of Engineering Pedagogy (iJEP), 12(2), pp. 115–128. https://doi.org/10.3991/ijep.v12i2.29331

[18] Al-Kindi, I. & Al-Khanjari, Z. (2021). Exploring Factors and Indicators for Measuring Students' Performance in Moodle Learning Environment. International Journal of Emerging Technologies in Learning (iJET), 16(12), 169-185. Kassel, Germany: International Journal of Emerging Technology in Learning. https://doi.org/10.3991/ijet.v16i12.22049

[19] Oz, C. T., Uzunboylu, H., & Ozcinar, Z. (2021). The Effect of Visual Design Self-Efficacy of Language Teachers on Mobile Learning Attitudes During the Pandemic Period. J. Univers. Comput. Sci., 27(5), 524-542. https://doi.org/10.3897/jucs.68902

[20] Smyrnova-Trybulska, E., Morze, N., & Varchenko-Trotsenko, L. (2022). Adaptive learning in university students' opinions: Cross-border research. Education and Information Technologies, 1-32. https://doi.org/10.1007/s10639-021-10830-7

[21] Jahangard, A., Rahimi, A., & Norouzizadeh, M. (2020). Student attitudes towards computer-assisted language learning and its effect on their EFL writing. International Journal of New Trends in Social Sciences, 4(1), 01–09. https://doi.org/10.18844/ijntss.v4i1.4785

[22] Purwanto, A., Rasyid, Y., Anwar, M., & Mayuni, I. (2022). Moodle-Based Flipped Learning-Model to Increase Basic Translation Skills and 21st Century Skills. Scope: Journal of English Language Teaching, 7(1), 01-10. http://dx.doi.org/10.30998/scope.v7i1.13891

7 Authors

Zhanat Seitakhmetova is a Ph.D. candidate from the School of Information Technology and Information Systems, East Kazakhstan Technical University, Serikbayeva 19, Ust-Kamenogorsk city, Kazakhstan (email: zhanat.seitahmetova@mail.ru, https://orcid.org/0000-0002-2312-989X).

Utebayeva Aliya Tulkibaevna is a Candidate of Pedagogical Science, Senior Lecturer of Shymkent university. Republic of Kazakhstan, Shymkent city, Riskulova st. 27/2 (email: Utebayeva.alia@shu.kz, https://orsid.org/0000-0002-7477-3212).

Aigul Sadvakassova has a Ph.D., is an Associate professor Department of Computer Science, L.N.Gumilyov Eurasian National University, K.Satpayev str., 2, Nur-Sultan, Kazakhstan (email: Sak79@bk.ru, https://orcid.org/0000-0001-8219-5515).

Akerke Ikenova is a Master of Natural Sciences, lecturer of the Department of Computer Modeling and Information Technology, Sarsen Amanzholov East Kazakhstan University, Al-Farabi street, 42/2 , Ust-Kamenogorsk city, Kazakhstan (email: erke_ikenova@mail.ru, https://orcid.org/0000-0002-4709-2075).

Raigul Karmenova, Master of pedagogical science, International school of Nur-Sultan, Turkistan 32/1, Kazakhstan (email: karmenova_r@isa.nis.edu.kz, https://orcid.org/0000-0002-5371-3165).

Gulnur Zhunussova, Master of computer science, senior lecturer of the Department of Computer Modeling and Information Technology, Sarsen Amanzholov East Kazakhstan University, Kazakhstan street, 55, Ust-Kamenogorsk city, Kazakhstan (email: vko_flower@mail.ru, https://orcid.org/my-orcid?orcid=0000-0001-9258-5066).

Article submitted 2022-08-08. Resubmitted 2022-09-19. Final acceptance 2022-09-21. Final version published as submitted by the authors.

Teachers' Perspectives on Innovative and Interactive Teaching Methods: Perspective of Mobile Learning

https://doi.org/10.3991/ijim.v16i23.36217

Fadil Latifi(✉), Hysen Kasumi
Faculty of Social Sciences, College AAB, Prishtina, Kosova
fadil.latifi@universitetiaab.com

Abstract—This study aims to reflect teachers' perspectives on the use of innovative and interactive teaching methods (mobile learning and others) and to present the importance of the application of modern teaching methods by first-level teachers *(grades 1-5)* and second-level teachers *(grades 6-9)*, in the development of student competencies. The research includes the Anamorava Region in Kosovo which covers an area of 650 km^2 and has about 200,000 inhabitants. Quantitative methods were used to research this issue, while Likert scale questionnaires were used as a tool for measuring teachers' thoughts and attitudes. The research sample consists of 97 teachers working with first and second-level students. The results show that teachers do not use a variety of methods while a number of them state that teaching methods are always in coherence with the age and skills of students. A small number of teachers pay special attention to students' prior knowledge. Based on the general data from the research, I have noticed that teachers do not practice enough modern teaching methods to develop students' competencies and promote their activity and creativity.

Keywords—Mobile Learning, Contemporary methods, perceptions, student activities, competencies, technology

1 Introduction

Teaching methods have a long history and since the beginning of educational work, they have always accompanied the process of learning development. In addition to the development of learning and the theoretical and practical basis of the organization of this activity, teaching methods have been developed, as an integral part of educational work [24] [26]. Quoting Jan Amos Komenski [25], [10] states that Komenski, Loku, Rousseau and Pestalozzi were all supporters of monomethodism (the use a single method) in teaching. In Chapter XVIII, when Komenski spoke of the "Basics of Easy Learning," among the ten requirements, the last requirement states that easy learning can be achieved "if all is developed by the same permanent method".

Attempts to update the universal method in later periods were made by Berthold Otto, Maria Montessori, etc [1]. Various representatives did not accept the universal method but tried to deny the need for the existence of teaching methods, emphasizing that "teaching work depends on the skill, dexterity and personal ability of the teacher"

[25]. Even in ancient Greece, teaching was based on teaching methods. Like [18] pointed out that the multimethod has been introduced since Greek mythology. Various scholars, such as Socrates, Plato and Aristotle made extensive use of teaching methods (polimethodism), and the Socratic method of conversation or Socrates' Dialogue is still popular nowadays. Some pedagogues [18], [20] demanded that instead of corporal punishment, teachers should use different teaching methods [2] [3].

According to [23], multimethodism should be understood as a requirement deriving from the differentiated character of the organization of learning based on numerous didactic modalities, according to which the active participation of students is a starting point in the selection and definition of methods. In contemporary teaching theory and practice, the issue of teaching methods has special importance, as they accompany the whole course of teaching development. According to [6], the action between the teacher and the student leads to the formation of a teaching method. Other [17] thinks that teachers need to have affirmative pedagogical approaches to the student to achieve the success they expect from students. While [24] has emphasized that the word method derives from the Greek language (methodos), which means the way or manner whereby one is guided when performing tasks and work actions.

The teacher's skill [24], [25] is one of the key factors in this case, he (the teacher) should "create interactive dynamics, trigger the curiosity and interests of students and thus make learning productive". Others [5] emphasized that the followers of active methods were directed with requests for a more pronounced manifestation of student participation in learning. Reform movements in pedagogy, such as that of the Active School, the New School, etc., also developed from the demand for the use of active methods. Polymethodism should be understood as a requirement deriving from the differentiated character of the organization of base on numerous didactic modalities, according to which student participation is the starting point in choosing and determining the methods, in addition to the subject to be mastered [25]. Some other [19] thinks that "advanced teaching methods for the classrooms are a guide to education about, through and for technology" [27]. "Teaching methodologies that are chosen to be used by teachers in their daily work are highly impacted by their attitudes and perceptions" [8].

Nowadays, many people think that using the right teaching method is critical in the learning process and also in the development of the new student. Some think that using the wrong method can lead the student to a bankruptcy stage, and push him or her to drop out of school. The correct use of teaching methods also affects the formation of students' personalities, enabling and preparing them for life and work, especially for self-education and self-education, as one of the most contemporary requirements of our school. As [22], [25] points out, there are many definitions of teaching methods, but they all include mainly the structures of the elaborations I did above, because they contain the meaning of the reasoning of the value of teaching methods, no matter how they are treated. The methods should aim at the joint work of the teacher and the students.

If we take a retrospective look at the development of teaching theory and practice, we see that some of the methods used today have been used in the past though in other terms and circumstances. From the didactic point of view, the issue of teaching methods has been and remains an integral part of the theoretical and practical activity of every

teacher. Permanent treatments of methods have left traces giving to different developments of this issue an importance in the organization of teaching work [7]. In the process of developing teaching methods both in the past and today, there are several attitudes still unharmonized, especially when it comes to the issue of their classification and the use of one or more teaching methods. Situational learning is often referred to as "culture" or as embracing norms, behaviours, skills, beliefs, languages, and attitudes of a certain community [15].

The development of teaching methods has gone through several stages, while the time of introduction of active methods with special emphasis on the active participation of students in learning is also important. Citing Schoenfeld [9] emphasizes that the perception that the teacher creates about teaching affects his or her outcomes. As [17] describes teaching methods talks about constructivism, where he emphasizes that from a constructivist point of view, learning is not a stimulus-response phenomenon. Quoting Piaget, [14] emphasizes that knowledge building is driven by internal processes such as organization, acquisition, and adaptation. New knowledge is abstracted from previous knowledge. Teachers should be based on the learning objectives within their teaching sets as well as the attitude that students should hold towards what they have benefited in the lesson [11], [12], [13], [16]. Has foreseen in the core curriculum document the innovative teaching methodologies that teachers must implement during the teaching [21].

According to [4] "everything must change once because otherwise, a static society will develop". The demand for the use of teaching methods derives from the essence of the organization of teaching work and the didactic-methodological structure of articulation of the teaching process.

2 Methods

2.1 The purpose of the research

This study aims to reflect teachers' perspectives on the use of innovative and interactive teaching methods (mobile learning and others) and to present the importance of the application of modern teaching methods by first and second-level students in Kosovo, in the development of student competencies.

2.2 Research hypotheses

H1. Teachers practice teaching methods that are not in line with the age of the students.

H2. Students are not active participants in the development of personal competencies.

H3. Technological tools (projector, laptop, etc.) are not practiced to the proper extent by teachers.

H4 Teachers still have a traditional approach to teaching where the student is not at the center.

2.3 Research methods

This research is based on the quantitative method of collecting and processing data that are structured and presented in numerical form. Data collection was based on primary data through the Likert scale questionnaire. For the purposes of the research, the questionnaire with 14 statements was used, as well as the space for comments by the respondents.

2.4 Participants

The population is numerically large, definite, and homogeneous. Our sample is intentional and randomly selected from the region of Anamorava, respectively including 3 municipalities, the municipality of Gjilan, Kamenica, and Vitia. For the sample, I have assigned 6 primary and lower secondary schools (nine-year) from these three municipalities, respectively three schools in urban areas and three other schools in rural areas. The survey procedures were performed by the first level teachers (grades 1-5) and the second level teachers (grades 6-9) of these 6 schools with 97 teachers.

2.5 Data collection instrument

The survey was conducted through a questionnaire compiled for teachers. And mobile learning teaching methods. The questionnaire was compiled according to the Likert scale within which 14 statements were placed. The questionnaire includes 5 possible alternatives, starting from alternative 1 fully agreeing with the statement, and alternative 5 which proves complete opposition to the given statement.

3 Results and discussion

The research sample included 97 teachers working in urban and rural areas. Table 1 presents the data of teachers by gender and age. The data show that the largest number of teachers is female and that the largest number of teachers is from 36 to 55 years old.

Table 1. Teacher demographic data

Data of primary and secondary school teachers regarding age and gender								
Age	25-35 age		36-45 age		46-55 age		56-65 age	
Gender	M	F	M	F	M	F	M	F
Class teacher	0 0%	15 15,46%	6 9,27%	26 26,80%	1 1,03%	12 12,37%	10 10,30%	4 4,12%
Subject teacher	0 0%	3 3,09%	1 1,03%	0 0%	2 2,06%	8 8,24%	7 7,21%	2 2,06%
In total	0 0%	18 18,55%	7 7,21%	26 26,80%	3 3,09%	20 20,61%	17 17,52%	6 6,18%

Note: Adapted from (Part of the PhD thesis unpublished): Contemporary teaching methods in primary and lower secondary schools, by F. Latifi, 2017, p. 149.

In the first question, I have presented in the questionnaire that teaching methods are key factors for the sustainable learning of students and I wanted to get the opinion of teachers whether they support the idea of whether teaching methods affect student learning or not. Out of 97 teachers surveyed in the three municipalities, 54 or 55.67% of them stated that teaching methods are every time a key factor to the sustainable learning of students, while 42 teachers or 43.29% stated about the alternative often. 1 teacher or 1.03% is stated for the alternative never or rarely.

The various activities and methods that the teacher plans to do with the students, in each case should be in full accordance with the skills and age of the students. Such a statement has also taken place in our questionnaire which I have prepared for teachers. Out of a total of 97 teachers surveyed, 71 or 73.19% of them stated that they adapt every time the teaching methods to the skills and age of the students, while 23 teachers or 23.71% stated the alternative often. For the alternative sometimes 2 teachers or 2.06% have been declared and 1 teacher or 1.03% of them has declared for the alternative never or rarely.

Table 2. Results of the survey of teachers from the municipalities of Gjilan, Kamenica, and Viti (Anamorava region)

Questions (q)	Every time	Often	Sometimes	Never or rarely	I do not know
Q1. Teaching methods are key factors for students' sustainable learning.	54 55,67%	42 43,29%	1 1,03%	0 0%	0 0%
Q2. I adapt teaching methods based on the age and abilities of the students.	71 73,19%	23 23,71%	2 2,06%	1 1,03%	0 0%
Q3. I use a variety of teaching methods to help stimulate students' ideas.	65 67,01%	28 28,86%	4 4,12%	0 0%	0 0%
Q4. Students' prior knowledge is essential in my teaching.	51 52,57%	41 42,26%	5 5,15%	0 0%	0 0%
Q5. Students actively participate in personal knowledge building.	35 36,08%	44 45,36%	16 16,49%	2 2,06%	0 0%
Q6. When working with students, i also use digital technology (computer).	5 5,15%	28 28,86%	37 38,14%	27 27,83%	0 0%
Q7. Using modern methods means even more noise in the classroom.	13 13,40%	54 55,67%	27 27,83%	3 3,09%	0 0%
Q8. We place students' work in the visible parts of the classroom.	56 57,73%	28 28,86%	12 12,37%	1 1,03%	0 0%
Q9. Contemporary teaching methods can be applied regardless of school conditions.	30 30,92%	56 57,73%	10 10,30%	1 1,03%	0 0%
Q10. Teaching methods should be in coherence with the learning unit being developed.	80 82,47%	14 14,43%	3 3,09%	0 0%	0 0%
Q11. Learning objectives are worthless if they are not consistent with teaching methods.	51 52,57%	25 25,77%	15 15,46%	6 6,18%	0 0%

Q12. I always answer students' questions	18 18,55%	48 49,48%	20 20,61%	11 11,34%	0 0%
Q13. Within the school year, we develop some learning units outside the classroom.	3 3,09%	26 26,80%	52 53,60%	16 16,49%	0 0%
Q14. At the end of the lesson, i ask students to reflect on what they have learned.	71 73,19%	24 24,74%	2 2,06%	0 0%	0 0%

Note: Adapted from (Part of the PhD thesis unpublished): Contemporary teaching methods in primary and lower secondary schools, by F. Latifi, 2017, p. 150.

The variety of methods is also one of the key factors that motivate students to keep the knowledge they receive longer and the same to be more functional. Given these facts, I have presented a statement in the questionnaire which requires the statement of teachers whether they use a variety of methods in their teaching or not. Out of 97 teachers surveyed, 65 teachers or 67.01% of them have stated every time, while 28 teachers or 28.86% have stated the alternative often. For the alternative, 4 teachers or 4.12% of them sometimes.

Given that students' previous knowledge is a good basis for building new knowledge, through a statement in the questionnaire, I wanted to get the opinions and attitudes of teachers during the teaching whether they build new knowledge on students' experiences or not. Out of 97 teachers surveyed, 51 or 52.57% stated alternative every time, while 41 teachers or 42.26% for the alternative often. 5 teachers or 5.15% stated declared sometime.

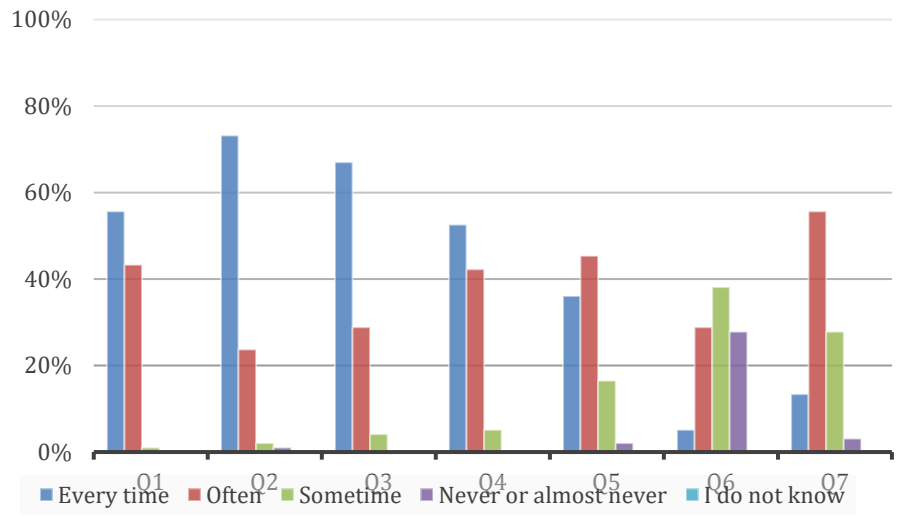


Fig. 1. Teachers' opinions from the first to 7 questions of the questionnaire

Note: Adapted from (Part of the PhD thesis unpublished): Contemporary teaching methods in primary and lower secondary schools, by F. Latifi, 2017, p. 152.

Active participation of students in personal knowledge building is essential if we want to have good results. It is not enough for the student to be present in the classroom and to acquire knowledge only through the "sense of hearing", but sustainable learning occurs when the student manages to connect theory with practice and life in general when critical thinking gives ideas and solutions in certain situations, in other words when he looks at the process from the inside and is not just a passive viewer. To see the active participation of students in knowledge building, I have presented in the questionnaire for teachers a statement where out of 97 teachers surveyed, 35 or 36.08% stated that students are every time active participants in knowledge building, while 44 or 45.36% for the often alternative. 16 teachers or 16.49% of them have stated sometimes, while 2 teachers or 2.06% have stated the alternative never or rarely. In the time we are living in, controlling information is almost impossible. They come not only from texts and textbooks but also other sources that today are very easily accessible and usable by anyone. Computers and other devices that enable access to the Internet enable us to access information within a very fast period. To see if teachers in their teaching use teaching technology, such as computers and projectors in their teaching, I asked them to choose one of the five identified alternatives in the statement presented in the questionnaire.

Out of 97 teachers surveyed, only 5 or 5.15% of them stated the alternative every time, while the alternative often was stated by 28 teachers or 28.86% of them. The alternative sometimes was stated by 37 teachers or 38.14% and 27 teachers or 27.83% stated the alternative never or rarely. The next statement concerns classroom management in general and discipline in the use of contemporary teaching methods and techniques. I have noticed that most of the teachers' opinions deviate from the alternatives from time to time and rarely, respectively from 97 teachers surveyed, regarding the alternative 13 teachers or 13.40% stated every time, while the alternative often was stated by 54 teachers or 55.67%. 27 teachers or 27.83% of them stated the alternative sometimes. In the next statement, I wanted to know if teachers practice working in pairs and groups as well as if their works are posted on the walls of the classroom and school. From the data, I have noticed that out of 97 teachers surveyed, 56 or 57.73% have stated the alternative every time, while 28 or 28.86% the alternative often. 12 teachers or 12.37% stated the alternative sometimes.

The use of modern teaching methods can be done only by knowing the procedures of teaching methods and techniques regardless of school conditions. One of the statements in the questionnaire is intended to note whether teachers agree that teaching methods can be used in whatever conditions the school offers. Out of 97 teachers surveyed, 30 or 30.92% of them have stated the alternative every time, while 56 or 57.73% of the teachers have stated the alternative often. 10 teachers or 10.10% rarely stated sometimes.

Teaching methods must be in full coherence with the learning unit that is developed so that the method has the effect for which it is intended, and this goal is to make it easier for students to learn and it is long-term. So, the teaching method or technique should be in full compliance with the teaching unit and not the other way around. During the data collection, I notice that teachers generally take this fact into account, and out of 97 teachers surveyed 80 or 82.47% have stated the alternative every time, while

14 teachers or 14.43 have stated the alternative often. 3 teachers or 3.09% of them stated the alternative sometimes.

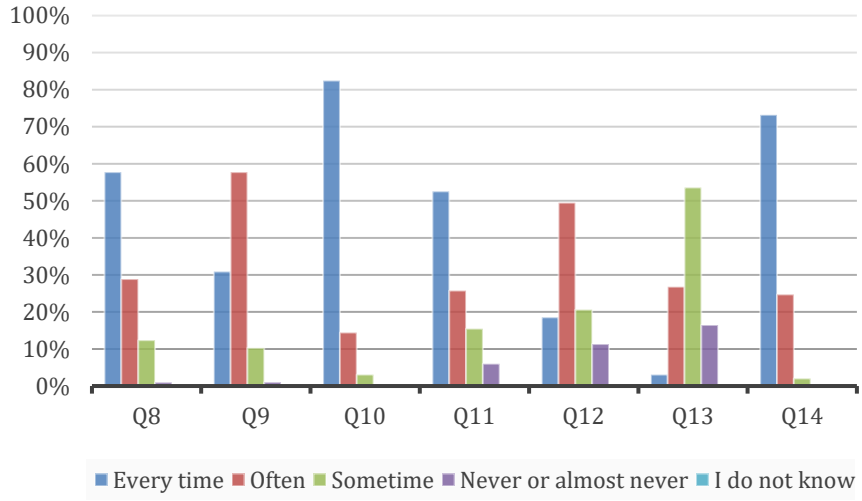


Fig. 2. Teachers' opinions from 8 to 14 questions of the questionnaire

Note: Adapted from (Part of the PhD thesis unpublished): Contemporary teaching methods in primary and lower secondary schools, by F. Latifi, 2017, p. 155.

It is well known that each preparation or plan outline of the teacher also contains the learning objectives that are thought to be achieved within the lesson. The importance of setting learning objectives is crucial given the fact that the objectives help us get to where I planned. All three processes, the learning unit, the learning, objectives, and the teaching methods must be in full coherence with each other. To see if the teachers present clear objectives for each teaching unit and if the objectives are in line with the teaching methods and if they are realized at the end of each lesson, in our questionnaire I have presented a statement by which I wanted to know whether teachers support these facts or not. Out of 97 teachers surveyed, 51 or 52.57% have always stated every time, while 25 teachers or 25.77% of them have stated the alternative sometimes. 15 teachers or 15.46% of them stated the alternative sometimes, while 6 or 6.18% never or rarely.

Through the next statement which asks the teachers to determine whether it is only them answering the students' questions or the answers are also given by the students, I have noticed that 18 of the teachers surveyed or 18.55% stated that they give the answers every time as teachers, while 48 teachers or 49.48% have stated the alternative often. Of the respondents, 20 teachers or 20.61% stated the alternative sometimes, while 11 teachers or 11.34% stated the alternative never or rarely. In most cases, the connection of theory with practice has the greatest effect on student learning.

To see if teachers make this connection by going out with students outside the classroom to conduct a lesson, in our questionnaire I have submitted a statement where I have asked teachers to state whether they practice such a thing or not. Out of 97 teachers

surveyed, 3 or 3.09% stated the alternative every time, while regarding the alternative 26 teachers or 26.80% of them stated often. 52 teachers or 53.60% stated the alternative sometimes, while 16 teachers or 16.49% the alternative never or rarely. Reflection is the part where teachers observe all phases of the lesson and verify whether certain objectives and methods have performed their function. This was also the last statement with which I wanted to get the opinions of teachers if they reflect at the end of each teaching unit to see if the set objectives have been achieved. Out of 97 teachers surveyed, 71 or 73.19% have stated the alternative every time, while 24 teachers or 24.74% have stated the alternative often. 2 teachers or 2.06%. stated the alternative never or never or rarely.

4 Conclusions

The use of innovative methods in teaching and their diversity affect students to develop the full competencies that are provided in the Kosovo Curricula. Through the use of contemporary methodology, we manage to develop students' cooperation, make them capable discussants of certain issues, develop interactive reading, encourage them to write and build writing skills, etc. In the first statement of the questionnaire for teachers, if teaching methods are key factors for sustainable learning, 54 teachers or 55.67% of them have stated the alternative every time, while 42 teachers or 43.29% stated the alternative often. Of 71 teachers or 73.19% of them stated that they every time adapt the teaching methods based on the age and abilities of the students. 65 teachers or 67.01% of them stated that they every time use a variety of teaching methods to help stimulate students' ideas. Teachers should keep in mind that students' prior knowledge is a good basis for building new knowledge. 51 teachers or 52.57% of them have stated that teachers keep this fact in mind every time.

Regarding the fact whether students are active in building their knowledge, 35 teachers or 36.08% have stated the alternative every time, while 44 teachers or 42.26% have stated the alternative often. Only 5 teachers or 5.15% stated that they every time use the computer in their teaching, while 28 or 28 28.86% of the teachers stated the alternative often. 37 teachers or 38.14% stated that they sometimes use the computer in teaching, while 27 teachers or 27.83% stated that they never or rarely use computers in teaching. If the use of modern teaching methods always causes noise in the classroom, 13 teachers or 13.40% are declared, while 54 teachers or 55.67% stated alternative often. 27 teachers or 27.83% stated the alternative sometimes and 3 or 3.09% the alternative never or almost never. 56 teachers or 57.73% of them stated that they every time put students' work in the classroom, while 28 or 28.86% stated the alternative often. Contemporary teaching methods can be applied at any time regardless of school conditions, 30 teachers stated or 30.92%, while 56 or 57.73% stated the alternative often. If the teaching methods should always be in coherence with the teaching unit that is developed, 80 teachers or 82.47% have been declared, while for the alternative 14 teachers or 14.43% have stated sometimes. Only 3 teachers or 3.09% stated the alternative every time I asked them if they develop any teaching units outside the classroom, while the alternative often was stated by 26 or 26.80% of the teachers. In the statement at the end

of the class, I ask students to reflect on what they have learned, 71 teachers or 73.19% have stated the alternative every time, while 24 or 24.74% have stated the alternative sometimes.

5 Acknowledgments

The author hereby states that this paper is a part of the Ph.D. research which is unpublished and developed by the same author. The author declares that the corresponding author, Hysen Kasumi, has contributed to the analysis of the research results and the evaluation of the teachers' views, and on this occasion, we would like to thank him for his contribution. The authors thank Mr. Armend Bislimi for his contribution in the linguistic aspect of the paper.

Conflicts of interest: The authors hereby state that he has no potential conflict of interest concerning the research, authorship, and/or publication of this article.

6 References

[1] Basariček, S. (1922). Pedagogia. Zagreb.
[2] Brada, R. (2005). Albanian language methodology for primary school. Peje: Dukagjini.
[3] Brada, R. (2010). Cyber Didactics, (Theory and Practice of Contemporary Learning). Peje: Dukagjini.
[4] Fullan, M. (2001). The New Understanding of Change in Education. Tirana: Edualba.
[5] Garo, S. (2013). Theory and practice of teaching. Tirana: Albania University Press.
[6] Giorgdze, M., & Dgebuadze, K. (2017). Interactive teaching methods: challenges and perspectives. International E-Journal of Advances in Education, III (9). https://doi.org/10.18768/ijaedu.370419
[7] Glasersfeld, E. V. (1995). A Constructivist Approach to Teaching. In L. P. Steffe, & J. Gale (Eds.), Constructivism in Education (pp. 3-15). Hillsdale: Erlbaum. http://www.vonglasersfeld.com/172
[8] Karanezi, X. and Rapti, E. (2015) Teachers' Attitudes and Perceptions: Association of Teachers' Attitudes toward Traditional and Modern Teaching Methodology According to RWCT as Well as Teachers' Perceptions for Teaching as a Profession. Creative Education, 6, 623-630. https://doi.org/10.4236/ce.2015.66061
[9] Karanezi, Xh., & Rapti.E. (2015). Teachers' Attitudes and Perceptions: Association of Teachers' Attitudes toward Traditional and Modern Teaching Methodology According to RWCT as Well as Teachers' Perceptions for Teaching as a Profession Creative Education. 6(6). https://doi.org/10.4236/ce.2015.66061
[10] O'Neill. P. (2008). The Educational Theory of Quintilian (Marcus Fabius Quintilianus). https://www.newfoundations.com/GALLERY/Quintilian.html
[11] Musai, B. (1996). Basic teaching skills. Tirana: Eurorilindja.
[12] Musai, B. (2003). Teaching methodology. Tirana: Pegi.
[13] Musai, B. (2009). How to write learning objectives for teaching and assessment. Tirana: CDE.
[14] Musai, B. (2013a). Teaching and learning natural sciences in grades 1-5 of primary school. Prishtina: GIZ.
[15] Musai, B. (2013b). Adult work, Coach guide, (manuscript) (p. 29).

[16] Musai, B. (2014). Teaching methodology. Tirana: Center for Democratic Education.
[17] Mwasalwiba, S.E. (2010). Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators. 52(1). https://doi.org/10.1108/00400911011017663
[18] Notturno, M., & Notturno, L. (n.d.). Teaching methods.Retrieved from http://www.jfdp.org/forum/forum_docs/1013jfdp54_1_040111090719.pdf
[19] Petrina, S. (2007) Advanced Teaching Methods for the Technology Classrooms. Canada. Information Science Publishing. Retrieved from https://books.google.com/books?hl=en&lr=&id=NXG9AQAAQBAJ&oi=fnd&pg=PR1&dq=teaching+methods+journals+article&ots=eoFRyV0sSS&sig=8EqO9srJ28vPzL0mUAebCVBo1o8#v=onepage&q=teaching%20methods%20journals%20article&f=false
[20] Piaget, J. (ca. 1936). The origins of intelligence in children. New York: W.W. Norton & Company, Inc.
[21] The Republic of Kosovo, Ministry of Education, Science and Technology. (2016). Curricular Framework of Pre-University Education of the Republic of Kosovo. Pristina MEST. http://www.ibe.unesco.org/fileadmin/user_upload/archive/curricula/kosovo/kv_alfw_2011_eng.pdf
[22] Yakovleva, O.N., & Yakovlev, V.E. (2014). Interactive teaching methods in contemporary higher education. Pacific Science Review. 16(2). https://doi.org/10.1016/j.pscr.2014.08.016
[23] Zylfiu, N. (1988). Didaktika 2. Prizren: Ramiz Sadiku.
[24] Zylfiu, N. (2005). Didaktika (Theory of teaching and learning). Prishtina: Timegate.
[25] Zylfiu, N. (2011). Learning theory and didactic teaching processes. Prishtina: Printing press.
[26] M. Ferizat and B. Kuat, (2021) "The effectiveness of interactive teaching methods in the professional training of pre-service geography teachers", CJES, vol. 16, no. 4, pp. 1976–1996. https://doi.org/10.18844/cjes.v16i4.6066
[27] M. Gulmira, Z. G. Nurbolatovna, Z. Nazym, M. G. Zholdasbekovna, S. Aigerim, and S. Dilyara, (2022). "Background to the development of technology of formation of teachers readiness for distance learning", WJET, vol. 14, no. 3, pp. 855–874. https://doi.org/10.18844/wjet.v14i3.7367

7 Authors

Dr.sc. Fadil Latifi is a professor at AAB College in Prishtinë, 10000, Kosovë. He has been working as a professor of Education Strategies at a Young Age since 2017. He is also the drafter of the Kosovo Curriculum, as well as the compiler of the degree test for pre-university education at MEST in Kosovo (ORCID; https://orcid.org/0000-0002-9832-6978, email: fadil.latifi@universitetiaab.com).

Dr.sc. **Hysen Kasumi** is a professor at AAB College in Prishtinë,10000, Kosovë. He has been working as a professor of Teaching Methodology since 2011 and has conducted several research dealing with Teaching Methodology (email: hysen.kasumi@universitetiaab.com).

Article submitted 2022-10-09. Resubmitted 2022-11-17. Final acceptance 2022-11-17. Final version published as submitted by the authors.

An Experimental Study in Determining Basic Robotic Coding Skills of Pre-School Students with Intellectual Disabilities

https://doi.org/10.3991/ijim.v16i23.36077

Ezgi Pelin Yildiz[1(✉)], Metin Çengel[2]
[1] Department of Computer Programming, Kafkas University, Kars, Türkiye
[2] Department of Computer Programming, Sakarya University of Applied Sciences, Sakarya, Türkiye
yildizezgipelin@kafkas.edu.tr

Abstract—Today, it can be said that coding has become a key competence for students and people working in many different fields in the business world. It is assumed that those who seek and develop new ways to learn-teach coding will be one step ahead. The educational use of coding started with the use of the Logo programming language in the 60s.This concept has started to revive in recent years with visual programming languages such as "Alice, its code, code.org and Scratch". These visual programming structures enable young learners to write applications without having to learn the complex code structures of traditional programming languages. In this study to develop an experimental study to determine the basic robotic coding skills of preschool students with intellectual disabilities. The sample of the study consists of a total of 20 students with studying in pre-school education institutions in a city in Türkiye. The ages of the students are between 5 years old. Semi-experimental design, one of the experimental research designs, was used in the research. In this context, 1 experimental and 1 control group was formed with the random assignment method. The materials used in both the experimental and control groups were determined as the pre-school robotic coding set U-bot starter package.5 weeks were determined as the teaching process and a total of 12 activities that served the purpose were applied to the students. During the applications, the data of the students were collected with the help of the observation form, coding skill test and after the application, they were collected through focus group interviews. As a result, at the end of the 5-week period, it was observed that there were positive significant changes in the two dependent variables (academic achievement andlearning rate) that were used as a basis for measuring the learning skills of both the experimental group and the control group students.

Keywords—robotic coding skills, U-bot starter package, pre-school children with mental retardation, kindergarten students

1 Introduction

The educational use of the concept of coding dates back to the 60s.When the literature is examined, there are four different orientations to coding education. These orientations consist of visual programming, programming with robotics, text-based programming and computer-free computer science, which is based on teaching coding concepts without using technological devices such as computers (Bower & Folkner 2015).

The concept of coding first started with the Logo programming language (Calao et al. 2015), and in recent years, it has started to become popular again through visual programming languages such as Alice, Code.org, and Scratch. These structures used by students consist of virtual structures based on producing their own games, animation, story and many other creativity in environments supported by visual programming languages (Taylor et al. 2010). The main purpose of using these environments is coding. It is based on the acquisition of other skills that are desired to be developed, rather than being taught. It is seen that after the application on these environments, the motivation of the children is increased by producing their own products (Resnick, 2013).

It is aimed to gain basic coding skills in the courses that are compulsory for 5th and 6th grade students and optionally taught to 7th and 8th grade students under the name of "Information Technologies and Software" in public schools in Türkiye. In addition to public schools, programming education has started to be given at pre-school levels in many private education institutions in the current system. For this purpose, it is aimed to train individuals who use information technologies effectively and efficiently (Uslu, Mumcu & Egin, 2018).

In today's world, where the importance given to coding education is becoming more widespread day by day, ensuring that it is more effective and meeting the needs through the trainings to be given is based on the acquisition of these skills starting from a young age.

2 Conceptual framework

When the literature on robotic coding education in the pre-school period is examined;

Altun (2018), investigated the effect of algorithm and coding education integration into the preschool curriculum on students' problem solving skills. The study group of the research conducted in the mixed pattern model consisted of 30 students in the age group of five attending a private kindergarten. In the research, 4 weeks of algorithm training and then 4 weeks of OSMO Coding training was given under the name of basic coding training."Problem Solving Skills Scale" was applied to all students before and after the application as a pre-test and post-test. As a result, at the end of the 4-week period, it was observed that there were significant positive changes in the development of problem solving skills of both the experimental and control group students.

Tagci (2019), investigated the effect of coding education on primary school students in her study. In the 2017-2018 academic year, 26 primary school students studying in a province of Türkiye were given 6-week training and an application was made regarding

this education. As a result, when the coding education skill test data were analyzed, it was seen that there was a statistically significant difference between the pre-test and post-test and the scores of the students in the coding skill test increased.

Curaoglu (2019), investigated the effect of algorithm and coding education integration into the secondary school curriculum on students' problem solving skills. The participants of the study consist of 26 volunteer students studying in a secondary school in a province in Turkey. The method of the research is based on mixed design. In the research, "Robotic Preliminary Questionnaire", "Robotic Satisfaction Test", "Problem Solving Inventory for Children" and "Activity Perception Scale" were used, observation and focus group interviews were conducted. According to the analysis of the collected data, it was seen that the five-week robotic coding training made a significant and positive contribution to the problem solving skill levels of the students.

2.1 Purpose and sub-objectives of the research

The general aim of the research is to develop an experimental study to determine the basic robotic coding skills of preschool students with intellectual disabilities. Within the framework of this general purpose, answers will be sought for the following sub-objectives:

- Is there a significant difference between the pre-test scores and the post-test scores for the academic achievement of the students who received algorithm and basic coding training?
- Is there a significant difference between the pre-test scores and the post-test scores for the learning rate of the students who received algorithm and basic coding training?
- What are the views of the students who receive algorithm and coding education about the learning process?

2.2 The importance of the research and its contribution to the literature

Today, children's acquaintance with technology has fallen at a very early age. It has been seen that it is recommended to give coding education in the pre-school period, which can transform the students' familiarity with technology into a positive one and improve their problem solving and critical thinking skills (Mittermeier, 2013; Kert &Uğras, 2009; Saygıner &Tuzun, 2017; Altun et al., 2021).

When the literature was searched, it was seen that the studies on coding education in the pre-school period were quite limited and they were generally studied with primary school and university students. It is thought that this research will contribute to the literature due to the scarcity of studies conducted in the preschool period in our country and will be a guide in terms of algorithm and coding education to be given in the pre-school period.

Counts. It is assumed that students have previous experience of using tablets.

Limitations. This study is limited to five age group special education students attending a private kindergarten in Adapazarı district of Sakarya province in Türkiye.

3 Method

In the research mixed design, in which qualitative and quantitative data were obtained, was used in order to determine the effect of algorithm and coding education to be given to five-year-old special education students attending pre-school education on learning skills. Johnson and Turner (2003) describe the mixed method as the collection of multiple data using different strategies, methods and approaches. True-experimental design, one of the experimental research designs, was used in the research. These are the patterns in which the subjects in the randomly created sample are randomly assigned to the groups (Creswell & Creswell, 2017). In this context, 1 experimental and 1 control group was formed with the random assignment method.

3.1 Study groups

The research was carried out with special education students in the age group of five attending a private kindergarten in the Adapazarı district of Sakarya in Türkiye province in the 2021-2022 academic year. The distribution of these students is given in Table 1.

Table 1. Study Group Distribution

Group	Male	Female	Method	Total
Experimental group	4	6	Algorithm+U bot	10
Control group	3	7	U bot training	10
	7	13		20

3.2 Data collection

Within the scope of the research, qualitative and quantitative data collection tools were used together. As a qualitative data collection tool, an observation form prepared by the researcher and focus group interview technique were used to monitor the learning process. Within the scope of the research, a total of two groups of special students attending kindergarten were studied. The first group received 4 weeks of algorithm training followed by 4 weeks of U-Bot Coding training, and the second group received 4 weeks of U-Bot Coding training without algorithm training.

3.3 Data collection tools

During the applications, the data of the students were collected with the help of the observation form, coding skill test and after the application, they were collected through focus group interviews.

Coding skill test. The main purpose of using skill tests in the study process is to determine the learning situations before and after the application and to determine to what extent they have achieved the skills they want to gain. For this purpose, a skill test was prepared by taking expert opinion. The prepared skill test consisted of 9 sub-

questions; types of questions such as short answer, true - false, matching, multiple choice were used. The skill test was administered to special students under the supervision of their teachers. Before the skill test data were analyzed, the test items were examined and a question pool was created. During this examination, total scores were obtained by giving 1 point for each correct answer and 0 for each incorrect answer and blank answer.

After obtaining the total scores, the total scores were ordered from the highest score to the lowest in order to determine the item discrimination index and item difficulty index on the skill test. Starting from the highest score in the ranking, 27% upper and lower groups were determined according to the lowest score. After determining the upper and lower groups, the item discrimination index and difficulty index were calculated. The coding skills pre-test and post-test results of the experimental and control groups are given in the Tables 2 and 3.

Table 2. Control Group Coding Skills Pre-test Results

		Pre-Test Activity Numbers												
	Student Coding:	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
1	**X1**	+	+	-	-	-	-	-	-	-	-	-	-	**10**
2	**X2**	+	+	-	-	-	-	-	-	-	-	-	-	**10**
3	**Y1**	-	+	+	+	-	-	-	-	-	-	-	-	**15**
4	**X3**	+	+	+	+	-	-	-	-	-	-	-	-	**20**
5	**Y2**	+	+	-	-	-	-	-	-	-	-	-	-	**10**
6	**Y3**	+	-	+	+	-	-	-	-	-	-	-	-	**15**
7	**Y4**	+	+	+	+	-	-	-	-	-	-	-	-	**20**
8	**Y5**	+	-	+	+	-	-	-	-	-	-	-	-	**15**
9	**X4**	+	-	+	-	-	-	-	-	-	-	-	-	**10**
10	**Y6**	+	+	+	+	-	-	-	-	-	-	-	-	**20**

Table 3. Control Group Coding Skills Post-test Results

		Post-Test Activity Numbers												
	Student Coding:	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
1	**X1**	+	+	-	-	-	-	-	-	-	-	-	-	**35**
2	**X2**	+	+	-	-	-	-	-	-	-	-	-	-	**40**
3	**Y1**	-	+	+	+	-	-	-	-	-	-	-	-	**30**
4	**X3**	+	+	+	+	-	-	-	-	-	-	-	-	**15**
5	**Y2**	+	+	-	-	-	-	-	-	-	-	-	-	**40**
6	**Y3**	+	-	+	+	-	-	-	-	-	-	-	-	**35**
7	**Y4**	+	+	+	+	-	-	-	-	-	-	-	-	**40**
8	**Y5**	+	-	+	+	-	-	-	-	-	-	-	-	**35**
9	**X4**	+	-	+	-	-	-	-	-	-	-	-	-	**25**
10	**Y6**	+	+	+	+	-	-	-	-	-	-	-	-	**40**

According to Table 2 and Table 3, the names of the students were kept hidden and only nicknames were given. Female students began to be coded with the nickname Y, male students with the nickname X. During the learning-teaching process, 12 activities were presented to the students in 5 weeks and the questions for these activities in the skill test were developed by the researchers. The score for completing each activity is determined as 5 points. The points that students will get from 12 activities are determined as a maximum of 60 and a minimum of 5 points. When the pre-test and post-test results of the control group were compared; results showed that the post-test scores of the control group students who received U-bot coding training had a positive and significant effect.

According to Table 4 and Table 5, the names of the students were kept hidden and only nicknames were given. Female students began to be coded with the nickname Y, male students with the nickname X. During the learning-teaching process, 12 activities were presented to the students in 5 weeks and the questions for these activities in the skill test were developed by the researchers. The score for completing each activity is determined as 5 points. The points that students will get from 12 activities are determined as a maximum of 60 and a minimum of 5 points. When the pre-test and post-test results of the experimantal group were compared; results showed that the post-test scores of the control group students who received Algorithm+U bot coding training had a positive and significant effect.

Table 4. Experimental Group Coding Skills Pre-test Results

		Pre-Test Activity Numbers												
	Student Coding:	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
1	**Y7**	+	+	-	-	-	-	-	-	-	-	-	-	**30**
2	**Y8**	+	+	-	-	-	-	-	-	-	-	-	-	**30**
3	**Y9**	-	+	+	+	-	-	-	-	-	-	-	-	**30**
4	**Y10**	+	+	+	+	-	-	-	-	-	-	-	-	**25**
5	**Y11**	+	+	-	-	-	-	-	-	-	-	-	-	**25**
6	**X5**	+	-	+	+	-	-	-	-	-	-	-	-	**30**
7	**X6**	+	+	+	+	-	-	-	-	-	-	-	-	**25**
8	**Y12**	+	-	+	+	-	-	-	-	-	-	-	-	**30**
9	**X7**	+	-	+	-	-	-	-	-	-	-	-	-	**25**
10	**Y13**	+	+	+	+	-	-	-	-	-	-	-	-	**25**

Table 5. Experimental Group Coding Skills Post-test Results

		Post-Test Activity Numbers												
	Student Coding:	1	2	3	4	5	6	7	8	9	10	11	12	**Total**
1	**Y7**	+	+	-	-	-	-	-	-	-	-	-	-	**50**
2	**Y8**	+	+	-	-	-	-	-	-	-	-	-	-	**50**
3	**Y9**	-	+	+	+	-	-	-	-	-	-	-	-	**40**
4	**Y10**	+	+	+	+	-	-	-	-	-	-	-	-	**40**
5	**Y11**	+	+	-	-	-	-	-	-	-	-	-	-	**55**
6	**X5**	+	-	+	+	-	-	-	-	-	-	-	-	**55**
7	**X6**	+	+	+	+	-	-	-	-	-	-	-	-	**50**
8	**Y12**	+	-	+	+	-	-	-	-	-	-	-	-	**55**
9	**X7**	+	-	+	-	-	-	-	-	-	-	-	-	**60**
10	**Y13**	+	+	+	+	-	-	-	-	-	-	-	-	**60**

3.4 Media and materials used in the experimental group

Fig. 1. U-Bot Preschool Robot Coding Kit - Starter Pack

Learning Goals:

1. Straight two steps

2. L two steps

4. Straight 2-3-2 step opposite

5. Straight 2-2-2 step target

3. 3-3 steps single target

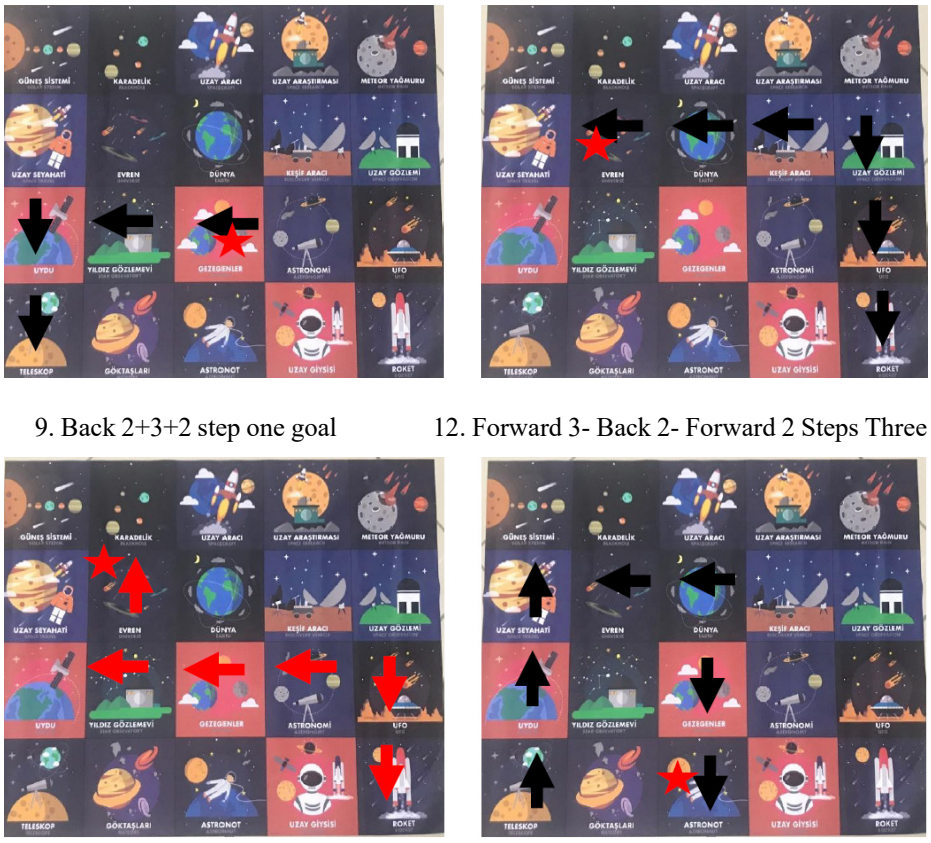
6. Straight 2-3-1 Step 3 target

7. Back 3 steps single target

10. Forward 2 Back 3 steps two goals

8. Back L 2+2 step single target

11. Back 3 forward 3 steps two goals



9. Back 2+3+2 step one goal

12. Forward 3- Back 2- Forward 2 Steps Three

Fig. 2. U-Bot Learning Target- Starter Pack

3.5 Comparison of pre-test post-test academic achievement and learning_rate scores of experimental groups and control group students

According to the Wilcoxon signed-rank test, the z values are -6.628, -6.781 and -6.780, and the significance level is below the critical value of .05. In this context, a significant difference was found between the pre-test and post-test scores of the experimental and control group students; this difference is in favor of posttest scores. In order to calculate the effect size of the difference, using the Wilcoxon signed-rank test effect size formula;

- For Experimental Group r = Z / √N (r= --6.628 / √180) r = -0.51
- For Control Group = Z / √N (r= --6.780 / √180) r = -0.51

Table 6. Pre-Test Post-Test Academic Achievement and Learning Rate Scores of Experimental Groups and Control Group Students

Groups	Pre-test Post-test	N	Rank Average	Df	z	p	Significant difference
Experimental	Negative Rank Postive Rank Indifferent	1 58 1	33.50 29.94	33.50 1736.50	6.628	.000	There is a significant difference between groups
Control	Negative Rank Postive Rank Indifferent	0 59 1	.00 30.00	.00 1770.00	6.780	.000	There is a significant difference between groups

Since this calculated effect size is greater than 0.5; it has been revealed that there is a significant difference between the pre-test and post-test scores of the experimental groups and the control group. This difference shows positive significance towards them in the post-test.

3.6 Learning process steps

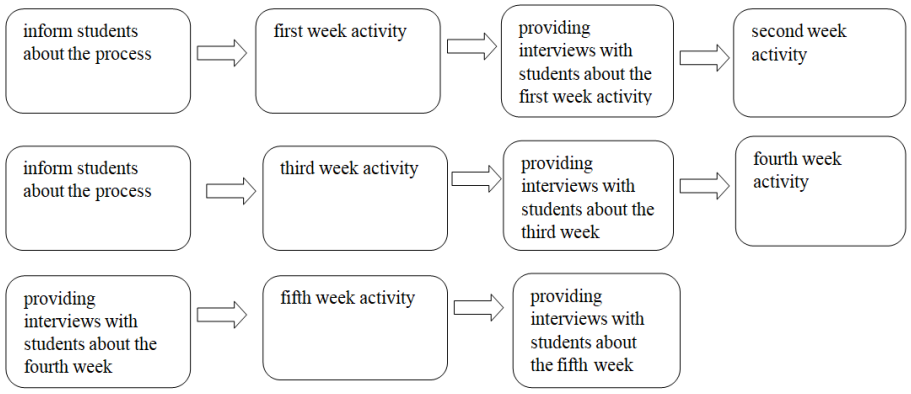


Fig. 3. The learning-teaching process steps followed for 5 weeks

Observation form and focus group interview. During the applications, the observations of the students were collected with the help of the observation form and after the application, the data were collected through focus group interviews. Qualitative data were collected through the observation form developed by the researcher and the audio recordings made during the focus group interviews after the application.

An observation form consisting of the steps of the coding education was developed by the researcher. The following stages were carried out in the preparation of the observation forms:

a) The scope of the observation forms was determined by scanning the literature.
b) The prepared observation forms were submitted to expert opinion for content validity. The observation forms were reviewed by the thesis advisor, a faculty member

from the preschool department, two experts in the field of educational technology, 2 special education teachers, and a specialist psychological counselor, and they were rearranged by making changes in line with their opinions.

c) Observation forms were applied to 5 special students.
d) After the preliminary application, necessary arrangements were made in the observation forms and the forms were given their final form.

Focus group discussions did not exceed 15 minutes. Between 6 and 8 students participated in each focus meeting. At the beginning of the interview, a few questions were prepared by the researchers to get the students' opinions and thoughts on the U-Bot application. These questions are:

- What comes to mind when you think of U-Bot?
- What can you do using U-Bot?
- What did you gain by using U-Bot?
- Would you like to use U-Bot in lessons?
- What comes to mind when you think of coding?

3.7 Findings obtained from focus group interview analysis

When the answers given by the students to the questions prepared for the focus group interview are examined;

- The students stated that they compared the u-bot to a ladybug and that they realized learning with the commands given by it.
- Although the students do not know how to read and write, they stated that they can easily learn the logic of coding with the U-bot.
- The students stated that the U-boot made them think, thanks to this they hovered and hopped on space and solar systems.
- "Would you like to use U bot in lessons?" all students gave an enthusiastic "yes" answer to the question. It is thought that the use of applications that attract the attention of students, facilitate their learning, and appeal to more sense organs in the teaching process make students more willing.
- When asked what comes to mind when you think of coding, students often said "robot".

4 Result, discussion & suggestions

In this study to develop an experimental study to determine the basic robotic coding skills of preschool students with intellectual disabilities. The sample of the study consists of a total of 20 students with studying in pre-school education institutions in a city in Türkiye. The ages of the students are between 5 years old. Semi-experimental design, one of the experimental research designs, was used in the research. In this context, 1 experimental and 1 control group was formed with the random assignment method. The materials used in both the experimental and control groups were determined as the pre-

school robotic coding set U-bot starter package.5 weeks were determined as the teaching process and a total of 12 activities that served the purpose were applied to the students. During the applications, the data of the students were collected with the help of the observation form, coding skill test and after the application, they were collected through focus group interviews.

The main purpose of using skill tests in the study process is to determine the learning situations before and after the application and to determine to what extent they have achieved the skills they want to gain. The prepared skill test consisted of 9 sub-questions; types of questions such as short answer, true - false, matching, multiple choice were used. During the learning-teaching process, 12 activities were presented to the students in 5 weeks and the questions for these activities in the skill test were developed by the researchers. The score for completing each activity is determined as 5 points. When the pre-test and post-test results of the control group were compared; results showed that the post-test scores of the control group students who received U-bot coding training had a positive and significant effect. When the pre-test and post-test results of the experimantal group were compared; results showed that the post-test scores of the control group students who received Algorithm+U bot coding training had a positive and significant effect. Pre-test and post-test results were analyzed with Wilcoxon significance test and positive and significant results of post-test results were revealed.

During the applications, the observations of the students were collected with the help of the observation form and after the application, the data were collected through focus group interviews. Focus group discussions did not exceed 15 minutes. Between 6 and 8 students participated in each focus meeting. At the beginning of the interview, a few questions were prepared by the researchers to get the students' opinions and thoughts on the U-Bot application. When the answers given by the students to the questions prepared for the focus group interview are examined; the students stated that they compared the u-bot to a ladybug and that they realized learning with the commands given by it. Although the students do not know how to read and write, they stated that they can easily learn the logic of coding with the U-bot.

When similar studies in the literature are examined; Konyaoglu (2019) tried to determine the opinions of secondary school students on robotic coding activities and designed a five-week, single-group experimental research in this context. The method of the research is based on mixed design. In the mixed design, qualitative and quantitative data were collected simultaneously and analyzed separately. In the research, "Robotic Preliminary Questionnaire", "Robotic Satisfaction Test", "Problem Solving Inventory for Children" and "Activity Perception Scale" were used, observation and focus group interviews were conducted. As a result, it is among the results of the research that the students participating in the research were very satisfied with the activities, their preliminary thoughts towards robotics were positive, and they enjoyed the activities and had fun.

The following suggestions can be given to educators who are interested in the subject;

- U-Bot robots were used in this study. Similar studies can be done with different educational robots.

- The duration of this learning is limited to a period of 5 weeks, two hours per week. In future studies, more activities can be organized by increasing the duration of the learning.
- Scientific studies investigating the effects of robotic coding education on students' creative thinking and collaborative studying skills will contribute to the field.

5 References

[1] Altun, M., Kocali, M., Durgun, S. & Sahin, S., K. (2021). *Arduino ile Robotik Kodlama Temel Seviye.* ISBN: 9789751156105.

[2] Altun, C., A. (2018). *Okul Öncesi Öğretim Programına Algoritma Ve Kodlama Eğitimi Entegrasyonunun Öğrencilerin Problem Çözme Becerisine Etkisi*. Unpublished master's thesis. Ankara Unıversıty Institute Of Educational Sciences Computer And Instructional Technologies Education Department Educational Technology Program.

[3] Bower, M. & Falkner, K. (2015). *Computational Thinking, the Notional Machine, Pre-service Teachers, and Research Opportunities*. Proceedings of the 17th Australasian Computing Education Conference (ACE 2015), Sydney, Australia.

[4] Caao, L., A. Leon, J., M., Correa, H., E. & Robles, G. (2015). *Developing Mathematical Thinking with Scratch An Experiment with 6th Grade Students.* DOI:10.1007/978-3-319-24258-3_2 Conference: Design for Teaching and Learning in a Networked World. 10th European Conference on Technology Enhanced Learning, EC-TEL 2015, Toledo, Spain, September 15–18, 2015, Proceedings At: http://link.springer.com/chapter/10.1007/978-3-319-24258-3_2

[5] Creswell. J.W. & Creswell, J.D. (2017) *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. 4th Edition, Sage, Newbury Park.

[6] Kert, S. B. &Uğraş, T. (2009). *Programlama Eğitiminde Sadelik ve Eğlence: Scratch Örneği*. 1st International Congress of Educational Research. 1st International Congress of Educational Research.

[7] Konyaoglu, C. (2019). *The effects of robotic coding education on the problem solving skills of secondary school students and the views of the students about robotic coding activities.* Unpublished master's thesis. Abant İzzet Baysal Unıversıty Institute Of Educational Sciences Computer And Instructional Technologies Education Department Educational Technology Program.

[8] Mittermeir, R.T. (2013). Algortihmics for preshoolers-A contradiction? *Creative Education, 4*(9), 557-562. https://doi.org/10.4236/ce.2013.49081

[9] Resnick, M. & Silverman, B. (2005). Some reflections on designing construction kits for kids. *Interaction Design and Children*, 117-122. https://doi.org/10.1145/1109540.1109556

[10] Saygıner, S., Tüzün &H. (2017) *İlköğretim Düzeyinde Programlama Eğitimi: Yurt DışıVe Yurt İçi Perspektifinden Bir Bakış,* 19. Akademik Bilişim Konferansı,Aksaray. [Çevrim-içi: http://ab.org.tr/ab17/bildiri/211.pdf].

[11] Uslu, N., Mumcu, F. & Eğin, F. (2018). Görsel Programlama Etkinliklerinin Ortaokul Öğrencilerinin Bilgi-İşlemsel Düşünme Becerilerine Etkisi, *Ege Eğitim Teknolojileri Dergisi, 2*(1): 19-31.

[12] Tagci, C., (2019). *Kodlama Eğitiminin İlkokul Öğrencileri Üzerindeki Etkisinin İncelenmesi.* Unpublished master's thesis. Afyon Kocatepe University Institute Of Educational Sciences Computer And Instructional Technologies Education Department Educational Technology Program.

[13] Taylor, A., H., Elliffe, D., Hunt, G., R. & Gray, R., D. (2010). Complex cognition and behavioural innovation in New Caledonian crows. Proceedings of the *Royal Society B: Biological Sciences 277* (1694): 2637-43. https://doi.org/10.1098/rspb.2010.0285

6 Authors

Asist. Prof. Dr. Ezgi Pelin Yildiz worked as an academic staff at Near East University in North Cyprus and Kafkas University in Turkey. Her specialisations are Educational Technologies, Instructional Design, Mobile Learning, Computer Technologies, Augmented Reality, Artificial Intelligence (email:yildizezgipelin@gmail.com).

Lecturer Metin Cengel worked as an academic staff at Sakarya University University of Applied Sciences University in Turkey. His specialisations are Mobile Learning, Computer Technologies, Augmented Reality, Artificial Intelligence, Applied Engineering Sciences (email: cengel@sakarya.edu.tr).

Article submitted 2022-10-14. Resubmitted 2022-10-26. Final acceptance 2022-10-26. Final version published as submitted by the authors.

Sensor Based Algorithm for Self-Navigating Robot Using Internet of Things (IoT)

https://doi.org/10.3991/ijim.v16i23.36213

Laurik Helshani(✉), Jusuf Qarkaxhija, Blerta Prevalla
Faculty of Computer Science, AAB College, Prishtina, Kosovo
laurik.helshani@universitetiaab.com

Abstract—The purpose of this paper is to show the design technique and programming of an autonomous robot prototype that can go to a predetermined location and return to its starting place utilizing the Global Positioning System (GPS). An HD camera along with an ultrasonic sensor and two IR sensors is used to provide necessary data from the real world to the robot to avoid obstructions, by following GPS Waypoints. A smart algorithm was introduced for path planning and re-planning. The robot can modify its direction using a digital compass reading and input from sensors by computing the heading angle from the current GPS point. This self-navigation mobile robot's accuracy was evaluated in several locations and is quantified in terms of heading angle and path length from the starting point to the goal point.

Keywords—autonomous mobile robot, fuzzy logic, OpenCV, GPS, IoT, python

1 Introduction

Robotics is a significant field of study that employs knowledge from several disciplines, including mechanics, electronics, and computer engineering, to move a mobile robot in a specified environment with some degree of autonomy [1]. The development of microcomputers, single board computers and embedded systems has helped to deploy low-cost solutions [2] for this very attractive and multidisciplinary field. In this paper we proposed a mobile robot platform which has a fixed four-wheel chassis. The platform was equipped with multiple sensors. Like any other path planning algorithm, the proposed algorithm based on fuzzy logic operates depending upon the position and orientation of the robot. GPS module, ultrasonic sensor and IR-sensors have been mostly used to gather essential data for obtaining current location coordinates of the robot in real time during its journey from source to goal point.

2 Related work

2.1 Design of low-cost self-navigation rover based on IoT [3]

The rover proposed in this study is capable of making its own decisions and moving in an unknown area without the assistance of humans. A camera module was installed on the Raspberry Pi board to better comprehend the challenges those ultrasonic sensors face. The rover's GPS allows it to indicate its whereabouts on the map. Using GPS-based navigation, a star (A*) algorithm is employed to find a path from source to destination. According to the authors, these findings can be used in the future to improve the implementation of self-navigation rovers with various sensors such as gas detection sensors, temperature sensors, and humidity sensors, among other things.

2.2 Comparative study on object tracking algorithms for mobile robot navigation in GPS-denied environment [4]

The goal of the study was to compare different algorithms under the same settings for the same set of criteria (such as accuracy and processing time). The Kalman filter (KF), extended Kalman filter (EKF), and particle filter are the techniques addressed and examined in this study for object tracking and location prediction of moving objects (PF). The scientists concluded that KF-based algorithms perform better in tracking slow-moving objects in dynamically cluttered GPS-denied situations for mobile robot navigation.

2.3 Design and implementation of autonomous car using Raspberry Pi [5]

The goal of this study was to show how to make a self-driving automobile prototype utilizing a Raspberry Pi as the processing unit. The writers employed a high-definition camera and an ultrasonic sensor to feed data from the actual environment into the automobile. The authors utilize the OpenCV image processing package to program autonomous cars. Using OpenCV, a unique approach for determining uneven, marked, or unmarked road margins is detailed.

To provide the autonomous automobile the required control, the authors merged numerous known algorithms such as lane detection and obstacle recognition. This approach is valid for all types of roads (whether they are designated with white lanes or not), according to one of the numerous conclusions of this research.

2.4 Mobile robot platform with Arduino Uno and Raspberry Pi for autonomous navigation [2]

A mobile robot platform with a fixed four-wheel configuration chassis and an electronic system based on the Raspberry Pi and Arduino Uno interfaces was suggested in this study. The robot's functioning is managed by a Raspberry Pi, a tiny single-board computer that is configured to handle mapping, navigation, obstacle detection, and

avoidance/transport. The Arduino Uno is a microcontroller board that can operate ultrasonic sensors, infrared sensors, and dc motors, among other things. The I2C synchronous communication protocol is used to transfer data between the Raspberry Pi and the Arduino. As a line follower robot with mapping, navigation, and obstacle avoidance capabilities, the mobile robot can travel through 2D surroundings.

The platform also includes a robotic arm with one degree of freedom (DOF) for lifting and transport.

3 Proposed design and implementation

3.1 Hardware development

Table 1. List of robot components

Component	Quantity
Raspberry Pi 4 Model B	1
Raspberry Pi Camera Module 2	1
DC Motor	4
Mini Motor Drive Shield Expansion Board L293D Module	2
GPS U-blox NEO-6M Module	1
HMC5883L Triple Axis Compass Magnetometer Sensor Module	1
Infrared Sensor Module	2
Ultrasonic Module HC-SR04	1
Mini Nickel-Plating Prototype Breadboard 170 Tie-points	2
Micro Servo SG90	1
HC-06 Wireless Bluetooth Transceiver RF	1
Multicolored Breadboard Dupont Jumper Wires (Male to Female)	12
Multicolored Breadboard Dupont Jumper Wires (Male to Male)	16
AAA Rechargeable Batteries 1.2V	6
Power Bank 10000mAh	1

Raspberry pi. Microcontroller chip designed by Raspberry Pi. It is the brain of the robot since here all the data is collected and processed. Every component of the robot is controlled from here. This chip is powered by Power Bank 10000 mAh.

GPS module. GPS U-blox NEO-6M: it is a low-cost device and tracks the current location of robot through GPS in form of latitude and longitude. Except latitude and longitude this device provides many more data.

Sonar sensor. Ultrasonic Module HC-SR04 measures the distance between the robot and an obstacle using ultrasonic sound.

Infrared sensor. IR-sensors are used to detect obstacles on the left and right of the robot.

This sensor module consists of an IR transmitter & an IR receiver. IR Transmitter continuously emits IR signal which is then reflected by an obstacle and is then detected by the IR receiver [6].

Triple Axis Compass. HMC5883L Triple Axis Compass Magnetometer Sensor Module. The robot can adjust its direction using a digital compass reading. It provides heading accuracy from to 1 to 2.

Bluetooth. HC-06 Wireless Bluetooth Transceiver RF. The robot is equipped with this device so that we can control it manually via Bluetooth. The robot must be paired with the mobile phone via Bluetooth. Then we can control it from the phone Bluetooth through the app.

Micro Servo SG90. The robot is equipped with a servo motor to make its head flexible to rotation. On the head of robot are mounted these three sensors: An ultrasonic sensor and two IR-sensors.

Raspberry Pi Camera Module. The Raspberry Pi camera can take high-resolution photos as well as full HD 1080p video, and it can be operated completely programmatically.

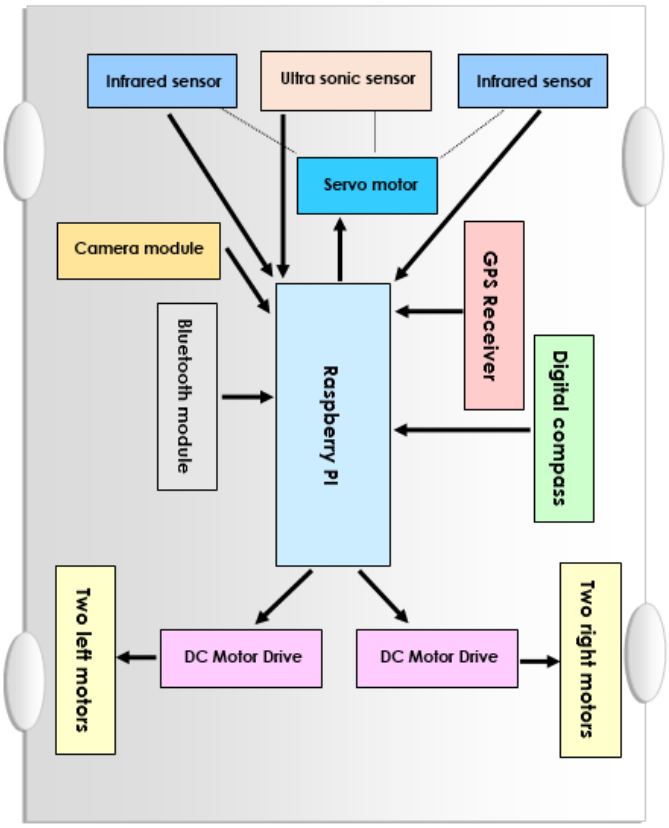


Fig. 1. Robot architecture

3.2 System development

The proposed Algorithm is developed in Python 3 programming language under Thonny IDE (**i**ntegrated **d**evelopment **e**nvironment) based on Fuzzy logic techniques.

The sensor-based Algorithm is an improvement of Fuzzy Logic Algorithm and manages at the same time navigation and obstacle avoidance tasks [8]. Moreover, it uses during its operation two other python libraries: OpenCV and RPi.GPIO.

OpenCV (Open-Source Computer Vision). It is a programming library geared mostly for real-time computer vision. It includes over 2500 efficient algorithms for image processing, detection and face recognition, object recognition, and other tasks. [10]

RPi.GPIO. The RPi.GPIO Python library allows you to easily configure and read-write the input/output pins on the Raspberry Pi. [7] GPIO must be imported on header within a Python script.

To perform the moveToNextPoint function, the proposed algorithm needs two parameters and data coming from the obstacle avoidance sensors, GPS sensor and images coming from HD Pi camera. Those two parameters are: distance between current position of robot and the next GPS waypoint, and the angle orientation (direction). To calculate the distance from current position to the next waypoint, the algorithm used the Haversine Formula (3), which gives the distance between two points on a sphere from their longitudes and latitudes. As for the direction or heading calculation, the algorithm uses the Forward Azimuth Formula (6).

$$a = sin^2(\Delta\varphi/2) + \cos\varphi_1 * \cos\varphi_2 * sin^2(\Delta\lambda/2) \quad (1)$$

$$c = 2 * atan2\ (\sqrt{(1-a)}, \sqrt{a}) \quad (2)$$

$$d = R * c \quad (3)$$

Where:

- φ_1 is the latitude of initial point;
- φ_2 is the latitude of the final point;
- λ_1 is the longitude of the initial point;
- λ_2 is the longitude of the final point;

$$\Delta\varphi = \varphi_2 - \varphi_1 \quad (4)$$

$$\Delta\lambda = \lambda_2 - \lambda_1 \quad (5)$$

- R is the radius of the Earth, expressed in meters (R = 6371 km) [9]

Note: That angles need to be in radius to pass to trig functions.

The azimuth can be found using the same latitudes and longitudes with the following equation:

$$\Theta = atan2[(sin\Delta\varphi_1 * cos\ \varphi_2),\ (cos\ \varphi_1 * \sin\varphi_2 - \sin\varphi_1 * \cos\varphi_2 * \Delta\lambda)] \text{ [9]} \quad (6)$$

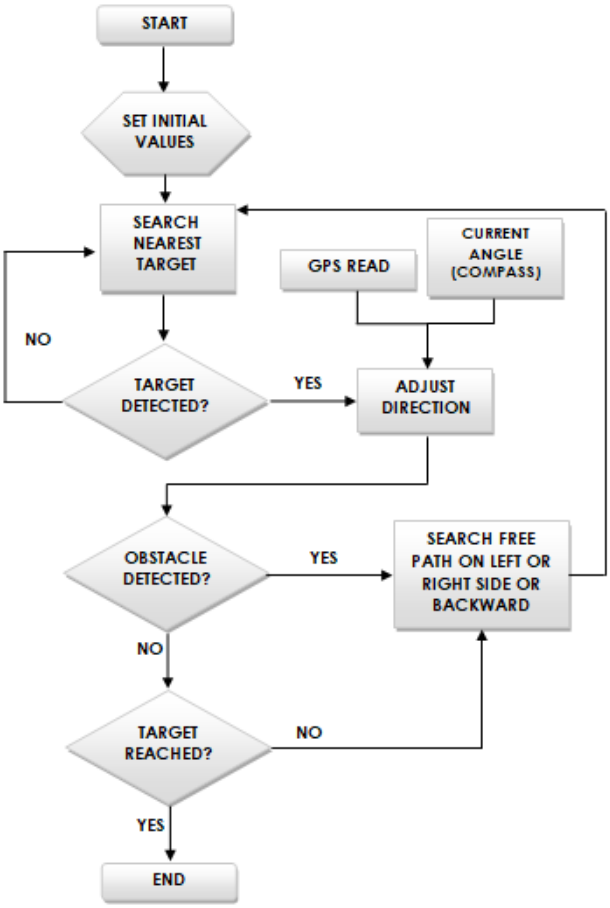


Fig. 2. Working flowchart of the proposed Algorithm

4 Results of tests and discussion

The robot has been tested in an outdoor and dynamic environment. The robot has been via Bluetooth controlled to traverse a test path. This path contains five way-points and based on their coordinates, this path is graphically represented on the Google Map as shown in Figure 3.

Fig. 3. Test route (5 way-points) on Google Map

The robot has independently (without any human interaction) traversed this path and returned to its starting point.

The obtained results are presented in tabular form. The waypoint-coordinates and path length (in meters) between each way-point of the route are given in Table 2.

Table 2. List of legths of way-points

Test. No.	Starting location	Target location	Distance using only sensors	Distance using camera and sensors
1	42.644563, 21.154925	42.644581, 21.155013	7.471 m	5.941 m
2	42.644581, 21.155013	42.644535, 21.154988	5.509 m	5.165 m
3	42.644535, 21.154988	42.644544, 21.154980	1.1957 m	1.144 m
4	42.644544, 21.154980	42.644545, 21.154914	5.399 m	4.891 m
5	42.644545, 21.154914	42.644559, 21.154750	13.504 m	11.452 m

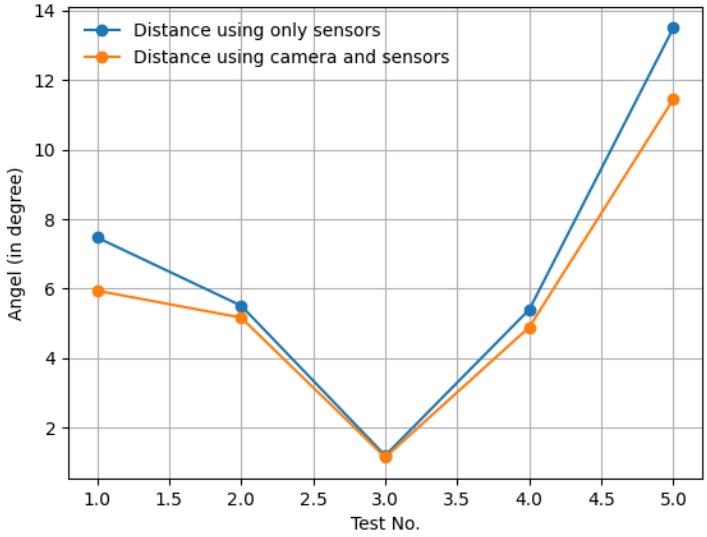


Fig. 4. Length between each of two way-points

The results in tabular form were presented graphically, writing small programs in the programming language python 3 and using the libraries: numpy and matplotlib.

As can be easily seen from the table above, the total length of all waypoints is shorter when the robot has used the sensors and camera. It happens, because the ultrasonic sensor does not detect obstacles so well without the help of the raspberry pi camera and the OpenCV library.

The robot must travel the longest distance to the object and recognize it as an obstacle, if it uses only the sensors. As a result, the total path length is longer than when using the camera.

Table 3. Table 1 List of angles and directions

Test. No.	Starting location	Target location	Distance	Current angle	Target angle
1	42.644563, 21.154925	42.644581, 21.155013	7.471	195.54	74.46
2	42.644581, 21.155013	42.644535, 21.154988	5.509	248.21	201.8
3	42.644535, 21.154988	42.644544, 21.154980	1.1957	123.18	326.8
4	42.644544, 21.154980	42.644545, 21.154914	5.399	178.82	271.2
5	42.644545, 21.154914	42.644559, 21.154750	13.504	173.38	276.6

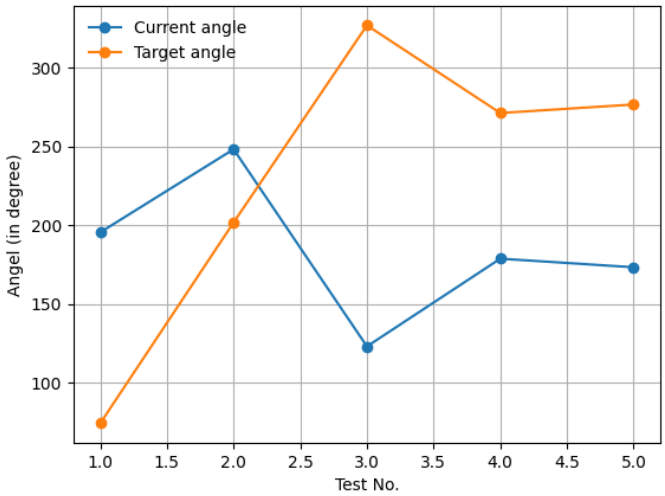


Fig. 5. Graphic representation of error and direction angle

During returning back to its initial starting coordinate, the Robot does not follow the previous route. The reason for this was that the GPS sensor did not provide data more often than 1 second and sometimes the data were not accurate. The consequence of this was that the length of the return route was longer.

The length of the return route was extended even further if the obstacle sensors detected on the road obstacles that were not along the initial route, due to the dynamic environment.

5 Conclusions

In this paper it was proposed a low-cost solution for a mobile robot platform with four-wheel chassis. This self-navigation robot has ability to move in static as well as dynamic environment. The sensor-based algorithm mentioned in the paper has been successfully implemented on this autonomous robot with a single board (microcontroller). This research work has utilized the power of IoT mechanism based on raspberry pi framework. The accuracy of the proposed algorithm, depends on the accuracy data coming from sensors and image frames from Raspberry Pi Camera Module.

6 References

[1] Akbari, M. (n.d.). Raspberry Pi GPIO Programming Using Python. (ElectroPeak) Retrieved April 03, 2022, from https://electropeak.com/learn/tutorial-raspberry-pi-gpio-programming-using-python-full-guide

[2] Hewawasam, H. S., Ibrahim, Y., & Kahandawa, G. (2019). Comparative Study on Object Tracking Algorithms for mobile robot Navigation in GPS-denied Environment. IEEE International Conference on Industrial Technology. https://doi.org/10.1109/ICIT.2019.8754960

[3] Howse, J., & Minichino, J. (2021). Learning OpenCV 4 Computer Vision with Python 3. Birmingham: Packt.
[4] Omrane, H., Masmoudi, M., & Masmoudi S., M. (2016). Fuzzy Logic Based Control for Autonomous Mobile. Computational Intelligence and Neuroscience. https://doi.org/10.1155/2016/9548482
[5] Pandure, D. S., & Yannawar, L. P. (2018). Design of Low Cost Self-Navigation Rover Based on IOT. Advances in Robotics & Automation, VII(2), 572-577. https://doi.org/10.4172/2168-9695.1000187
[6] Pannu, G., Ansari, M., & Gupta, P. (2015). Design and Implementation of Autonomous Car using Raspberry Pi. International Journal of Computer Applications, 113, 22-29. https://doi.org/10.5120/19854-1789
[7] Rubio, F., Valero, F., & Llopis-Albert, C. (2019). A review of mobile robots: Concepts, methods, theoretical framework, and applications. International Journal of Advanced Robotic Systems. https://doi.org/10.1177/1729881419839596
[8] Stelian-Emilian, O. (2019). Mobile Robot Platform with Arduino Uno and Raspberry Pi for Autonomous Navigation. 12th International Conference Interdisciplinary in Engineering.
[9] Szyk, B. (2021, April 09). Azimuth Calculator. Retrieved April 03, 2022, from https://www.omnicalculator.com/other/azimuth
[10] TCRT5000 Infrared Reflective Sensor Module. (2015). (DNA) Retrieved April 03, 2022, from https://www.dnatechindia.com/tcrt5000-infrared-reflective-sensor-module.html

7 Authors

Laurik Helshani is a professor in department of Computer Science at AAB College since 2018. Since 2017 he works as Software development manager at Devolli Group company. His field of research is software engineering and artificial intelligence

Jusuf Qarkaxhija, PHD, for five years in a row is in the position of Dean of the Faculty of Computer Science at AAB College and also a longtime teacher at the same Faculty. He is the author of over 30 scientific papers in highly indexed journals and participant in many activities inside and outside Kosovo. He has worked in many other institutions, both in higher education and in industry. It is his tenth year of work experience at AAB College.

Blerta Prevalla, PHD, is a full-time professor at the Faculty of Computer Science at AAB College, with many years of experience. She is also the author of over 20 scientific papers in prestigious international journals. She has worked in many institutions, both in university education and in industry holding different positions like Dean of the Faculty at AAB College, Vice Dean, IT Consultant for World Bank project etc.

Article submitted 2022-09-26. Resubmitted 2022-10-27. Final acceptance 2022-10-27. Final version published as submitted by the authors.

Technology Acceptance Model and Learning Management Systems: Systematic Literature Review

https://doi.org/10.3991/ijim.v16i23.36223

Nadire Cavus[1,2](✉), Babatomiwa Omonayajo[1,2], Melissa Rutendo Mutizwa[1]
[1] Department of Computer Information Systems, Near East University, Nicosia, Cyprus
[2] Computer Information Systems Research and Technology Centre, Near East University, Nicosia, Cyprus
nadire.cavus@neu.edu.tr

Abstract—As the Internet has evolved rapidly, Learning Management Systems in recent years, particularly during the pandemic era, have become increasingly popular and can effectively override time and gives people new insights into the education field. A substantial amount of research was performed on a Technology Acceptance Model (TAM) framework and popularity in Learning Management Systems, in general, was indicated. However, there are gaps in established awareness of representative academic literature that form the basis of research in LMS and TAM. The summary of the current research effort on TAM implementation in the area of LMS is the main objective of this systematic literature review. This systematic literature review found 21 related studies between 2010 and 2020 based on the aim of this research through the systematic search of the most popular scientific databases. We hope that the findings of the review will inspire institutional administrators and users to recognize the factors that influence the quality and effectiveness of the use of LMS by TAM.

Keywords—Technology Acceptance Model, adoption, learning management systems, higher education, users

1 Introduction

The Learning Management Systems (LMS) is a common information system that many institutions around the world are equipping to improve the quality of education [1]. Unlike traditional learning environments, modern LMS provides a gamified environment to learners, making it more engaging and interactive, enabling learners to complete courses, while having a fun learning experience [2]. The Learning Management Systems assists students in the management, communication, and review of the class schedule, work submissions, assessments, and interactions with schoolmates [3]. The instructor can distribute quizzes, materials, and messages to students through a Learning Management system and save time [4]. Therefore, they have ample time to inspire students for better understanding and thoughts [5], especially during this COVID-19 pandemic for instance [6]. Today, most of LMSs have a mobile version that can be used

on mobile devices more easily, So, it can be said that LMS is the most important platform for mobile learning (m-learning), which is cost-effective, more engaging, and more accessible than traditional learning methods. Moreover, mobile learning applications/platforms such as LMS provide valuable support for lifelong learning. Today, all individuals must adopt lifelong learning [7] so that they can survive in the competitive world.

Traditionally, the Learning Management Systems have been studied using the Technology Acceptance Model (TAM), which is a theoretical information system that maps how the users embrace and use technology, the true implementation of the system at the end-point of technology use, and the behavioral intention that leads people to the use technology [8]. The TAM has been one of the most prominent models in technological acceptance with two primary elements affecting the user's decision to use a learning development system or, more broadly, any new technology: perceived ease of use and perceived usefulness. The perceived ease-of-use (PEOU), according to [9] is the extent to which a user feels that the use of a specific system is easy to operate while perceived usefulness is the user's perspective that using a certain system improves their performance, in context of students' academic performance, motivation, and engagement. Similar to [10], an individual feels that improving a certain device improves the efficiency of their usage [11]. These two variables are the main determinants of the adoption and application of information technology by individuals [12]. Also, these two variables form the basis of the system attitude such that the actual behavior is generated [13]. In this study, the literature is reviewed systematically, to offer a critical description of ongoing research activities and empirical data on the predictive validity available so far on Technology Acceptance Model and Learning Management Systems, and to define future research perspectives.

1.1 The aim of the study

This study aims to identify, review and analyze representative academic literature on Technology Acceptance Model and Learning Management Systems with the following research questions:

- RQ1: How is the distribution of the related studies on publication year and LMS's user?
- RQ2: How has the Technology Acceptance Model influenced students and instructors using learning management systems?
- RQ3: What are the future suggestions proposed to TAM and LMS?

2 Methodology

2.1 Research setting

A search of peer-reviewed papers underlying studies on the Technology Acceptance Model and Learning Management Systems was observed using the systematic literature

review method. This methodology adopted a PRISMA research technique for meta-analyses and systematic reviews. As a checklist, PRISMA is not just an instrument for quality assessment of systematic reviews; in all parts of articles such as title, summary, introduction, process, results, and discussion, it can be very useful for critical evaluation goals [14]. Related scientific studies have been chosen using a three-phase approach covering data collection, data analysis, and reporting the review.

2.2 Research strategy

For this study, Scopus, Web of Science, Science Direct, EBSCO, and IEEE Xplore are specifically selected for their key presentations of articles and journals on their platforms. Full-text journals were examined to select papers to be included in the study and the papers which did not meet the included criteria were excluded. The key strings used in the research are ("TAM" OR "Technology Acceptance Model" OR "Adoption") AND ("Learning Management System" OR "LMS") AND ("Higher Education" OR "University"). Ten years from 2010 to 2020 were used as the search filters for the period of the study.

2.3 Selection criteria

A few criteria were considered before selecting papers to achieve the primary goal of obtaining papers that are appropriate for the study. The criteria for the selection were based on language, which was limited to English, and on published papers that only focused on TAM and LMS under computer science topics from 2010 to 2020. These parameters provided a straightforward roadmap for determining which papers are appropriate for our study.

Table 1. Data collection and description

Data collection	Description
Database	Papers downloaded from Scopus, Web of Science, Science Direct, Springer Link, and IEEE Xplore.
Search keywords	("TAM" OR "Technology Acceptance Model" OR "Adoption") AND ("Learning Management System" OR "LMS") AND ("Higher Education" OR "University").
Date of publications	Studies published between 2010 and 2020.
Language of publications	The studies will be restricted to those published in English.
Included criteria	• Studies that focus on Technology Acceptance Model or/and learning management systems. • Studies carried out under computer science topic. • Studies published from 2010 to 2020. • Studies published only in peer-reviewed journals/Articles.
Excluded criteria	• Studies using models other than Technology Acceptance Model in learning management systems. • Studies that are open access or not full texts will be excluded

2.4 Selection criteria

The data analysis identified several terms as guidelines to capture and report the literature findings. The search results were obtained from the five scientific databases that are most popular all over the world. The detailed selection process of the studies can be seen in Figure 1.

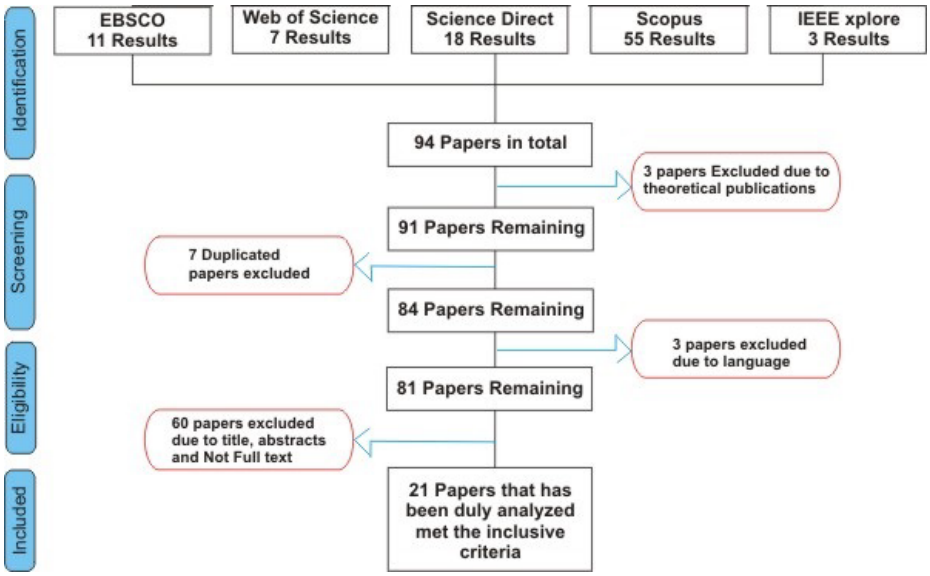


Fig. 1. Flow diagram of the publication selection process

At the beginning of the search in the chosen scientific databases which is the PRISMA research technique's identification stage, 94 articles were acquired that included "TAM" or "Technology Acceptance Model" alongside the keyword "Learning Management System" or "LMS" and "Higher Education" or "University" as described in the title of the publication. Since these were the findings of the search in all five databases, the screening and eligibility stages were observed to find papers that are truly relevant to our study. In that process, 3 papers were omitted due to theoretical writing, and 7 replications were removed as well, resulting in 84 academic publications with distinct titles. To guarantee the relevance of content concerning requirements of inclusion criteria, the title, abstract, and text were examined (full-text publications and languages). During this procedure, 60 publications were removed due to the title, abstracts, and not full-text: three (3) due to the language issues (not English), resulting in 21 papers that have been duly analyzed and aligned with the inclusive criteria in the included stage of the PRISMA research technique.

2.5 Data extraction

The following information was extracted from the study in the data extraction stage:

- Author(s)
- The aim
- Research type
- Participants
- Most important findings

2.6 Data extraction quality assessment

The assessment of the quality of any research project is critical. This paper assessed the quality of the final 21 papers whose aim is to improve the selected articles by determining the objectives of each article, their most important results, the research types, and participants. Participants of the selected articles are categorized into instructors and students, and related studies' research methods are identified as survey, interview, or systematic analysis. The details of the related studies' assessments can be seen in Table 2 below.

Table 2. Analyzed information from the related studies

Reference	Aim of Study	Research Type	Participants	Most Important Findings
[15]	Evaluating models defining the preference for performing tasks using either LMS or alternate means and illustrating the importance of effective usage and ease of use.	Survey Method	Instructors	A two-step process, inspired by its usefulness and ease of use, is one of the above models, which offers the clearest persuasive representation of the decision process.
[16]	Explaining the various tools inside LMS from a technology acceptance perspective should be identified.	Survey Method	Instructors	TAM refers to the level of the combination of methods and tasks. This particular LMS tool was inspired by the utility of software and simple use.
[17]	To research the impact of LMS on student experience and e-learning satisfaction.	Survey Method	Students	The findings showed an ease of use and usefulness between computer anxiety and students. The characteristics of the students are important to promote the acceptability and satisfaction of the positive use of LMS.
[18]	Explaining the factors that impact user expectations and collaborative technology adoption.	Survey Method	Students	For project-based learning, the TAM can be extended to group developments by extending the TAM by combining additional factors directly relevant to research innovation.
[1]	Results of e-learning system use for hybrid courses were examined.	Survey Method	Students	Students put little emphasis on their perceived ease of use, as their prediction of perceived learning assistance is poor and their perceived usefulness is placed more on their analysis when assessing the impact of e-learning systems.

[19]	Explanation of individual decision-making in academic environments to consider and assimilate e-learning.	Survey Method	Students	Direct ties among the core aspects of the original TAM indicate strong beneficial effects. The perceived ease of use affects behavioral intention quite positively.
[20]	Reviewed the application of university e-learning programs and recognize factors promoting the use of LMS by students.	Survey Method	Students	Perceived usefulness and perceived ease of use affect each other positively.
[21]	To identify and evaluate the most commonly identified external variables by reviewing TAM study studies.	Survey Method	Students	The external variables most commonly used are the method, material and information quality, device automaticity, subjective standards, enjoyment, and accessibility. The consistency of the systems and knowledge has positive effects on the usefulness of e-learning for students.
[22]	To investigate studies also interprets the difference in the generation to be useful in technology for students and teachers.	Survey Method	Students	Students are more experts in using technology since there is a slight gap between generations in the perceived usefulness and significance of digital technology.
[23]	Proposing a TAM model that would explain how young school students continue to use LMS. This model was verified.	Survey Method	Students	These results supported findings from past literature that perceived ease of use can influence the perceived influence and thus influence satisfaction positively and strongly.
[24]	To study what motivates students to replace LMS for information sharing and collaboration using cloud-based file hosting services.	Survey Method	Students	In cloud file hosting, it is very easy to use and more user-friendly than LMS which students use because they are not user-friendly and are obligatory.
[25]	Exploring the compatibility between the use of the e-learning framework and its performance.	Survey Method	Students	The results suggested that the relationship between e-learning and academic success can be moderated if compatibility is perceived.
[26]	Factors to explore influence customer acceptance of e-book use by implementing a model which integrates the acceptance of the technology model.	Survey Method	Students	The study found significant support for the hypothesized model, and optimistic and significant correlations between the updated TAM and the intention of users to continue the use of e-books.
[27]	The main factors influencing flow experiences and their role in using them were studied in this document (LMS).	Survey Method	Students	The study shows that perceived knowledge has a favorable association with flow experience, which means that students' capacity to strengthen institutions should be strengthened and returned to effective performance.

[28]	Using Moodle to assess the perceived utility and usability of students.	Survey Method	Students	The study showed that students perceive Moodle utility and perceive difficulties in integrating Moodle, which greatly leads to how students rate Moodle students.
[29]	To test if U-learning is capable of transforming conventional classroom education.	Systematic Review	Students	Traditional schooling can be modified by the use of learning. This is primarily because students observe real and faithful environments at various school levels.
[30]	Developing countries like Pakistan recognize the effect of essential problems that generate obstacles for e-learning flows.	Interviews	Others (e-learning experts)	At least 16 existing critical issues were established which serve as obstacles in Pakistan's e-learning institutions.
[31]	This paper presented emerging developments of methods such as virtual education in the standardization of computer-based education.	Survey Method	Others (the components of the e-learning standardization process)	Official standardized, many of which are under the basis of current decisions and proposals, are highly dynamic standards of delivery.
[32]	Understanding contact recognition and communication skills.	Survey Method	Students	Increasing students' communicative willingness, which is a precondition for improving successful communication, were effective learning techniques implemented to minimize their communications anxiety.
[33]	The instructors' understanding is focused on a common LMS blackboard method.	Survey Method	Instructors	Educators were able to see meaning and success shaped the priorities of the board. Training influenced perceived utility but did not influence satisfaction. PC self-sufficiency doesn't have any effect on obvious usefulness.
[34]	This research explored the effect of human factors on LMS efficacy in a mixed learning setting at high schools in Kuwait.	Survey Method	Students	Help, gain, knowledge, and trust are the factors that have the greatest impact on user satisfaction and have a positive effect on a good LMS and speed.

3 Results

3.1 The publication year and LMS's users of the related studies

The graphs below summarize the year the related studies are published and the participants of the related studies.

This research selected 21 final papers after the collected papers were analyzed and the papers were published between the years 2010 and 2020 as illustrated in the graph Figure 2 and Table 2 respectively. As seen in Figure 2, there is a noticeable change before and after the year 2016. The increase in 2014 and 2018 could be a result of LMS being more popular and how papers were now not only focused on the technical usage

of LMS but also the factors that influence students or instructors' usage of LMS [34], [17].

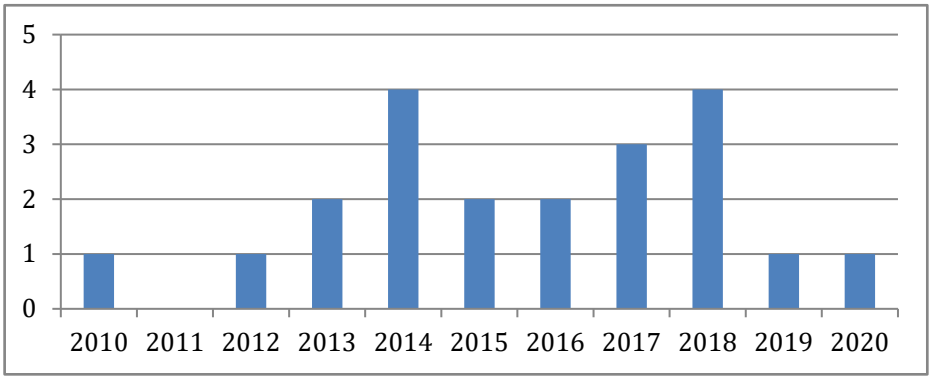


Fig. 2. Papers published yearly

It can be seen in Figure 3 and Table 2 that the related studies focus on both students and instructors, the majority focus on the students because this sector of the participant is the main reason the TAM and LMS came into existence. The systematic review found that sixteen papers focus on the adaptation [22], [24], [25], [29], [32], satisfaction [1], [17], [18], [20], [21], [23], [27], [28], [34], and intention [19], [26] of the students. On the other hand, only three papers [15], [16], [33] concentrated on instructors based on perceived usefulness, ensuring that LMS delivers its function accordingly. As a result, it has been observed that most research in the past has focused more on the students than instructors (shown in Figure 3 and Table 2) in the learning environment as they are both users of the learning management systems.

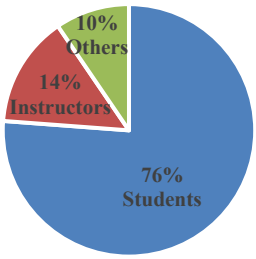


Fig. 3. Distribution of LMS users in the literature

3.2 How Technology Acceptance Model influence students and instructors using learning management system

TAM influencing LMS's users (students and instructors) is based on perceived usefulness and perceived ease of use aimed at their purpose to use the systems and understanding that real use influences user satisfaction and user satisfaction influences future intention to use the system. [23] and [20] indicated that while perceived ease of use does not contribute significantly to the intention of using LMS in the early stages, its relationship to the use of LMS and the contentment of LMS in the latter stage becomes greater. Also, they stressed that perceived usefulness has a stronger relationship with the purpose and satisfaction of students and instructors than perceived ease of use, but perceived ease of use also has a substantial positive effect on perceived usefulness. It can be said that students using e-learning technologies learn with ease in mandatory contexts and have a positive experience of continuous use of LMS.

[22] and [15] underlined that students are better suited to LMS with a little variation in the purpose and usage of LMS for learning and teaching. Task importance influences users in making choices to either perform a specific task or not and choices between performing the task using the LMS or not. While on the other hand as stated by Schoonenboom [16], the low LMS purpose can be explained by low task or performance and usefulness or ease of use of systems. [18] and [33] highlighted that the ability to share information, training, user-interface design, and technical support is aimed and conducted towards the learning platforms in the collaborative learning environment. Perceived usefulness (PU) affects the assurance of LMS, and then both perceived usefulness and satisfaction are influenced by the user's continuous intentions to use the learning management systems. [17] and [21] also found that certain factors like quality of systems, systems performance, information quality, and perceived enjoyment affects satisfaction on students' perceived ease of use and usefulness of LMS and consequently their satisfaction. On the other hand, [28] underlined the fact that users' perceived usefulness and challenges of LMS combined, contribute significantly to users' rate of LMS usage.

3.3 Future suggestions proposed to TAM and LMS

Every technology has its great advantages and limitations, past research has shown many limitations and proposed insight into future improvements. [1] and [25] suggesting future studies should concentrate on how students' perceived assistance will be enhanced through the incorporation of important design-related features such as significance, clarification, institution, communication, etc., in developing great e-learning systems. Also, more research has been made into how a cooperative e-learning environment can be developed to affect the students' academic performance positively [17], [20-23], and the impact on the outcomes of the e-learning systems, use of other significant aspects which have been established in previous studies [27]. The ideas of further development have been proposed to explore how the behavior of users can influence e-learning outcomes, to create other advantages that LMS can assist to improve the effects of e-learning and analyze how this behavior can affect students' group support.

On the other hand, [24] suggested that future designs should involve other variables such as computer anxiety, subjective norm or perceived behavioral control and role of personality traits, users' continual LMS-intentions, such as the design of a sampling system that links individuals with less computer expertise to improve causal-causality skills. [23] and [18] suggested that future research can provide more objective details on the framework usage of students and concentrate on finding additional decomposed concepts that can further clarify students' motivational perception in LMS. Also, [32] and [34] suggested that future studies should be pursued to better assess communication skills using the treatment and tracking community trials to explore the causal linkages between active learning policies and other communication levels so that problems overcome can be better understood and future solutions for these challenges can be studied. More research is needed to fill the gaps in the attention provided to instructors, as instructors are also essential to the effectiveness of LMS.

4 Discussion

We are living in an age of advanced technology, which affects our lives in numerous ways and which has changed the political, social, economic, and cultural spheres. In modern society, educational environments have been recognized as a strong channel for knowledge innovation. Also, a wide range of educational technology is involved which supports the translation and acquisition process of information. As a result, research on technology acceptability has become increasingly common in the field of Learning Management Systems [35], [36] and the Technology Acceptance Model is generally accepted as a good framework for planning and carrying out observational studies in educational affairs [8]. The most highlighted result in this study was that perceived usefulness and perceived ease of use were the main factors influencing intention and continuous usage of LMS. This result was supported by Sensuse and Napitupalu [20], Cheng and Yeung [23], and [1] in their studies that for maximum results, perceived ease of use and perceived usefulness complement each other and positively affect each other. Even when it comes to selecting an LMS tool to use as stated by Essel and Wilson [28] students perceive usage and difficulties will influence how they will rate the tool. The presented study analyzes the academic literature in Learning Management Systems concerning the Technology Acceptance Model. The research analysis provides a broad variety of tested learning technologies with various research methods based on technology acceptance shedding light on the topic. New extensions and modifications of the model are proposed to encompass various factors affecting the decision to adopt and accept, instead of rejecting a particular technology in the learning and teaching environment. Instructors are as important [37-40] as their students because, without the instructors, students will have a limited understanding of acquired knowledge or no knowledge at all. Since education needs students and instructors [41-44] to be effective, they must also be in the LMS, so future studies should focus more on instructors as well.

Also, the COVID-19 pandemic situation has been a great advantage to the learning management systems [45-47] which has brought about the growth of the LMS in major

parts of the world and has boosted the perceived usefulness and ease of use of users to achieve satisfaction and delivery of its purpose [15], [19] as LMS stands as the only means to continue education process without delays. Before the COVID-19 pandemic, LMS was considered a waste of time as it is less preferred than attending lectures in classes [48-50]. Also, LMS is likely to be a fresh start in the global education sector, where the bulk of operations will be carried out by Learning Management Systems [51-53]. Therefore, a curriculum that enables recognizable changes in student learning awareness, experience, and critically thinking must be built and governments must ensure that effective communications resources with high-quality digital learning experiences are available to support technology-enabled learning for students during and after the COVID-19 pandemic [54] as COVID-19 pandemic has given the educations circle an idea of LMS usefulness. Researchers, institutions, and even students and instructors should integrate online learning platforms and concentrate more on LMS adoption based on the pandemic situation as it might take more years before things go back to normal. But factors that affect the intention to use and the success of LMS should be identified. From this perspective, the results of this systematic literature review can be kept light to researchers in this area [55-57].

5 Conclusion

In recent years, Learning Management Systems got more popular among researchers because LMS involves a wide range of users of learning technology which should support the process of knowledge transfer and acquisition. However, new technologies like LMS should be searched before integrating human life if they can adapt and be accepted by potential users. In this context, the Technology Acceptance Model is accepted by researchers in the literature as a suitable model to identify factors that affect users' opinions on adaption and acceptance of the new technology. As a result of this, TAM research in the field of LMS has become increasingly popular. The result of this systematic literature review found that TAM is widely acknowledged as a solid frame for planning and conducting evaluation in the field of education, especially when it comes to instructors as an essential aspect of the LMS. Also, it was determined that the studies that investigated the factors affecting the use of LMS by teachers were not sufficient. Consequently, more focus and efforts should be placed on instructors in the future in the context of LMS usage. Moreover, a variety of factors affecting the decision to follow and approve LMS in the learning environment are proposed to be included in new extensions and revisions of TAM and LMS. We hope that the findings of this review can create awareness of the important role of LMS in e-learning, and give ideas to the educational institutes' administration and teachers to identify that the factors that affect the quality and success of LMS usage by the TAM can be used.

Some of the limitations encountered in this research were choosing the databases with the specified keywords therefore in future research; the database can be extended to other popular scientific databases. The data range is another limitation of the study which may be wide in future studies to analyze literature in more detail.

6 References

[1] Islam, A. N. (2013). Investigating e-learning system usage outcomes in the university context. Computers & Education, 69, 387-399. https://doi.org/10.1016/j.compedu.2013.07.037

[2] Turnbull, D., Chugh, R., & Luck, J. (2020). Learning Management Systems, An Overview. Encyclopedia of education and information technologies, 1052-1058. https://doi.org/10.1007/978-3-319-60013-0_248-1

[3] Çavuş, N. (2020). Evaluation of MoblrN m-learning system: Participants' attitudes and opinions. World Journal on Educational Technology: Current Issues, 12(3), 150-164. https://doi.org/10.18844/wjet.v12i3.4978

[4] Cavus, N. (2013). Selecting a learning management system (LMS) in developing countries: instructors' evaluation. Interactive Learning Environments, 21(5), 419-437. https://doi.org/10.1080/10494820.2011.584321

[5] Piña, A. A. (2012). An overview of learning management systems. Virtual Learning Environments: Concepts, methodologies, tools and applications, 33-51. https://www.igi-global.com/chapter/content/63117

[6] Aljarrah, A. A., Ababneh, M. A. K., & Cavus, N. (2020). The role of massive open online courses during the COVID-19 era: Challenges and perspective. New Trends and Issues Proceedings on Humanities and Social Sciences, 7(3), 142-152. https://doi.org/10.18844/prosoc.v7i3.5244

[7] Ramirez-Asis, E. H., Srinivas, K., Sivasubramanian, K., & Jaheer Mukthar, K. P. (2022). Dynamics of Inclusive and Lifelong Learning Prospects Through Massive Open Online Courses (MOOC): A Descriptive Study. In Technologies, Artificial Intelligence and the Future of Learning Post-COVID-19 (pp. 679-696). Springer, Cham. https://doi.org/10.1007/978-3-030-93921-2_35

[8] Charness, N., & Boot, W. R. (2016). Technology, gaming, and social networking. In Handbook of the Psychology of Aging (pp. 389-407). Academic Press. https://doi.org/10.1016/b978-0-12-411469-2.00020-0

[9] Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. Management Science, 35(8), 982-1003. https://doi.org/10.1287/mnsc.35.8.982

[10] Mathwick, C., Malhotra, N. K., & Rigdon, E. (2002). The effect of dynamic retail experiences on experiential perceptions of value: an Internet and catalog comparison. Journal of Retailing, 78(1), 51-60. https://doi.org/10.1016/s0022-4359(01)00066-5

[11] Jahangir N. and Begum, N. The role of perceived usefulness, perceived ease of use, security, and privacy, and customer attitude to engender customer adaptation in the context of electronic banking. *African Journal of Business Management*, vol. 2, no. 2, pp. 32-40, 2008. https://doi.org/10.5897/AJBM.9000634

[12] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 319-340. https://doi.org/10.2307/249008

[13] Salman, A., Abdullah, M. Y. H., Aziz, J., Ahmad, A. L., & Kee, C. P. (2014). Remodelling technology acceptance model (TAM) in explaining user acceptance towards information and communication technology. International Journal of Arts & Sciences, 7(1), 159. https://search.proquest.com/openview/853cec8bb2675ee1a3984c07c83e9f1a/1?pq-origsite=gscholar&cbl=626342

[14] Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Annals of internal medicine, 151(4), 264-269. https://doi.org/10.1371/journal.pmed.1000097

[15] Schoonenboom, J. (2012). The use of technology as one of the possible means of performing instructor tasks: Putting technology acceptance in context. Computers & Education, 59(4), 1309-1316. https://doi.org/10.1016/j.compedu.2012.06.009

[16] Schoonenboom, J. (2014). Using an adapted, task-level technology acceptance model to explain why instructors in higher education intend to use some learning management system tools more than others. Computers & Education, 71, 247-256. https://doi.org/10.1016/j.compedu.2013.09.016

[17] Ghazal, S., Al-Samarraie, H., & Aldowah, H. (2018). "I am still learning": Modeling LMS critical success factors for promoting students' experience and satisfaction in a blended learning environment. Ieee Access, 6, 77179-77201. https://doi.org/10.1109/access.2018.2879677

[18] Cheung, R., & Vogel, D. (2013). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. Computers & Education, 63, 160-175. https://doi.org/10.1016/j.compedu.2012.12.003

[19] Al-Gahtani, S. S. (2016). Empirical investigation of e-learning acceptance and assimilation: A structural equation model. Applied Computing and Informatics, 12(1), 27-50. https://doi.org/10.1016/j.aci.2014.09.001

[20] Sensuse, D. I., & Napitupulu, D. (2017). The study of user acceptance toward E-learning System in Higher Education. Indonesian Journal of Electrical Engineering and Computer Science, 7(2), 466-473. http://doi.org/10.11591/ijeecs.v7.i2.pp466-473

[21] Salloum, S. A., Alhamad, A. Q. M., Al-Emran, M., Monem, A. A., & Shaalan, K. (2019). Exploring students' acceptance of e-learning through the development of a comprehensive technology acceptance model. IEEE Access, 7, 128445-128462. https://doi.org/10.1109/access.2019.2939467

[22] Salajan, F. D., Schönwetter, D. J., & Cleghorn, B. M. (2010). Student and faculty inter-generational digital divide: Fact or fiction? Computers & Education, 55(3), 1393-1403. https://doi.org/10.1016/j.compedu.2010.06.017

[23] Cheng, M., & Yuen, A. H. K. (2018). Student continuance of learning management system use: A longitudinal exploration. Computers & Education, 120, 241-253. https://doi.org/10.1016/j.compedu.2018.02.004

[24] Stantchev, V., Colomo-Palacios, R., Soto-Acosta, P., & Misra, S. (2014). Learning management systems and cloud file hosting services: A study on students' acceptance. Computers in Human Behavior, 31, 612-619. https://doi.org/10.1016/j.chb.2013.07.002

[25] Islam, A. N. (2016). E-learning system use and its outcomes: Moderating role of perceived compatibility. Telematics and Informatics, 33(1), 48-55. https://doi.org/10.1016/j.tele.2015.06.010

[26] Jin, C. H. (2014). Adoption of e-book among college students: The perspective of an integrated TAM. Computers in Human Behavior, 41, 471-477. https://doi.org/10.1016/j.chb.2014.09.056

[27] Khan I. U., Hameed Z., Yu Y. and Khan S. U. (2017). Assessing the determinants of flow experience in the adoption of learning management systems: the moderating role of perceived institutional support. *Behaviour & Information Technology*, vol. 36, no. 11, pp. 1162-1176. https://doi.org/10.1080/0144929x.2017.1362475

[28] Essel, D. D., & Wilson, O. A. (2017). Factors affecting university students' use of Moodle: An empirical study based on TAM. International Journal of Information and Communication Technology Education (IJICTE), 13(1), 14-26. https://doi.org/10.4018/ijicte.2017010102

[29] Cárdenas-Robledo, L. A., & Peña-Ayala, A. (2018). Ubiquitous learning: A systematic review. Telematics and Informatics, 35(5), 1097-1132. https://doi.org/10.1016/j.tele.2018.01.009

[30] Farid S., Ahmad R., Niaz I. A., Arif M., Shamshirband S. and Khattak M. D. (2015). Identification and prioritization of critical issues for the promotion of e-learning in Pakistan. *Computers in Human Behavior*, vol. 51, pp. 161-171. https://doi.org/10.1016/j.chb.2015.04.037

[31] Anido-Rifón, L. E., Fernández-Iglesias, M. J., Caeiro-Rodríguez, M., Santos-Gago, J. M., Llamas-Nistal, M., Sabucedo, L. Á., & Pérez, R. M. (2014). Standardization in computer-based education. Computer Standards & Interfaces, 36(3), 604-625. https://doi.org/10.1016/j.csi.2013.09.004

[32] Lie, T. (2017). The Effect of Active Learning Strategies on Communication Apprehension in Information Systems Students in Taiwan. IEEE Transactions on Professional Communication, 61(1), 101-109. https://doi.org/10.1109/tpc.2017.2747378

[33] Mouakket, S., & Bettayeb, A. M. (2015). Investigating the factors influencing continuance usage intention of Learning management systems by university instructors: The Blackboard system case. International Journal of Web Information Systems. https://doi.org/10.1108/ijwis-03-2015-0008

[34] Alomari, M. M., El-Kanj, H., Alshdaifat, N. I., & Topal, A. (2020). A framework for the impact of human factors on the effectiveness of learning management systems. IEEE Access, 8, 23542-23558. https://doi.org/10.1109/access.2020.2970278

[35] Al-Busaidi, K. A. (2010). 'Learners' acceptance of learning management systems: Developing a theoretical framework,''. In Proc. 4th Int. Multi-Conf. Soc., Cybern. Inform. https://squ.pure.elsevier.com/en/publications/learners-acceptance-of-learning-management-systems-developing-a-t

[36] Cavus N., Mohammed Y. B. and Yakubu M. N. (2021). An artificial intelligence-based model for prediction of parameters affecting sustainable growth of mobile banking apps. *Sustainability*, vol. 13, no. 11, 6206. https://doi.org/10.3390/su13116206

[37] Prahani, B. K., Alfin, J., Fuad, A. Z., Saphira, H. V., Hariyono, E., & Suprapto, N. (2022). Learning Management System (LMS) Research During 1991-2021: How Technology Affects Education. International Journal of Emerging Technologies in Learning (iJET), 17(17), pp. 28–49. https://doi.org/10.3991/ijet.v17i17.30763

[38] Jauhiainen, S., Krosshaug, T., Petushek, E., Kauppi, J.-P., & Äyrämö, S. (2021). Information Extraction from Binary Skill Assessment Data with Machine Learning. International Journal of Learning Analytics and Artificial Intelligence for Education (iJAI), 3(1), pp. 20–35. https://doi.org/10.3991/ijai.v3i1.24295

[39] Huseyin, U., & Gönül, A. (2020). A content and citation analysis of the studies on learning environments and special education. International Journal of Cognitive Research in Science, Engineering and Education, 8(2), 95-104. https://cyberleninka.ru/article/n/a-content-and-citation-analysis-of-the-studies-on-learning-environments-and-special-education

[40] Prodani R., Çobani S., Andersons A. and Bushati J., (2022). Digital technologies integration in the classroom. A teacher's perspective. *Cypriot Journal of Educational Science*, vol. 17, no. 8, pp. 2823-2837, 2022. https://doi.org/10.18844/cjes.v17i8.7781

[41] Nazim, M., & Alzubi, A. A. F. (2022). Evaluation of an online teacher-made test through blackboard in an English as a foreign language writing context. World Journal on Educational Technology: Current Issues, 14(4), 1025–1037. https://doi.org/10.18844/wjet.v14i4.7614

[42] Badrudin, B., Khusnuridlo, M., & Wahyu, M. Z. E. (2022). The influence of learning management information system and service quality on the customer satisfaction of Ruangguru

application. Cypriot Journal of Educational Sciences, 17(1), 148–158. https://doi.org/10.18844/cjes.v17i1.6692

[43] Salama, R., Qazi, A., & Elsayed, M. (2018). Online programming language—Learning management system. Global Journal of Information Technology: Emerging Technologies, 8(3), 114–123. https://doi.org/10.18844/gjit.v8i3.4051

[44] Zhiyenbayeva, N., Sabirov, A., Troyanskaya, M., Ryabova, E., & Salimova, S. (2022). Implementing a conceptual model of participative management into an integrated e-learning system. World Journal on Educational Technology: Current Issues, 14(1), 255-267. https://doi.org/10.18844/wjet.v14i1.6723

[45] ALRikabi, H. T. S., Abdul-Rahman Al-Malah, D. K., Hassan Majeed, B., & Z. Abass, A. (2021). The Influence E-Learning Platforms of Undergraduate Education in Iraq. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 9(4), pp. 90–99. https://doi.org/10.3991/ijes.v9i4.26995

[46] Al-Zoubi, A. Y., Dmour, M.., & Aldmour, R. (2022). Blockchain as a Learning Management System for Laboratories 4.0. International Journal of Online and Biomedical Engineering (iJOE), 18(12), pp. 16–34. https://doi.org/10.3991/ijoe.v18i12.33515

[47] Al-Shammari, A. H. (2020). Social Media and English Language Learning during Covid-19: KILAW Students' Use, Attitude, and Prospective. Linguistics Journal, 14(1). https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/en/covidwho-863753

[48] Jahangard, A., Rahimi, A., & Norouzizadeh, M. (2020). Student attitudes towards computer-assisted language learning and its effect on their EFL writing. International Journal of New Trends in Social Sciences, 4(1), 01–09. https://doi.org/10.18844/ijntss.v4i1.4785

[49] Bianco, N. D.., Giaconi, C., Gison, G., D'Angelo, I., & Capellini, S. A. (2021). Inclusion at the University through technology: A case study in Italy. International Journal of Special Education and Information Technologies, 7(1), 01–15. https://doi.org/10.18844/jeset.v7i1.6793

[50] Mozombite-Jayo, N.., Manrique-Jaime, F., Castillo-Lozada, S.., Romero-Andrade, C.., Giraldo-Retuerto, M., Delgado, A., & Andrade-Arenas, L. (2022). Systemic Analysis of the Use of Technological Tools in the University Learning Process. International Journal of Engineering Pedagogy (iJEP), 12(4), pp. 63–84. https://doi.org/10.3991/ijep.v12i4.30833

[51] Alanazi, K., & Thompson, C. (2019). Using social networking technologies to promote language socialisation: English as foreign language teachers' perceptions in Saudi Arabia. Global Journal of Foreign Language Teaching, 9(3), 122–136. https://doi.org/10.18844/gjflt.v9i3.4129

[52] Karaca, A. (2020). Innovative technologies and living spaces; Updated living standards according to the evolution of homo sapiens. New Trends and Issues Proceedings on Advances in Pure and Applied Sciences, (12), 91–108. https://doi.org/10.18844/gjpaas.v0i12.4990

[53] Uzunboylu, H., & Gundogdu, E. G. (2018). A Content Analysis Study on Pre-School Education and Instructional Technologies. International Journal of Innovative Research in Education, 5(4), 119–128. https://doi.org/10.18844/ijire.v5i4.3974

[54] Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. International Journal of Educational Research Open, 1, 100012. https://doi.org/10.1016/j.ijedro.2020.100012

[55] Adebayo, D. O., Julius, E., & Fasasi, L. (2019). Incidence of Yahoo-Plus activities among in-school adolescents in Delta State, Nigeria. Global Journal of Guidance and Counseling in Schools: Current Perspectives, 9(1), 14–23. https://doi.org/10.18844/gjgc.v9i1.3950

[56] Devedzic, V., & Devedzic, M. (2019). Technology-Enhanced Assessment at universities and in schools: An initiative. International Journal of Learning and Teaching, 11(3), 89–98. https://doi.org/10.18844/ijlt.v11i3.4319

[57] Akhondi, A., Y. Yarmohammadian, M., & Â Haghani, F. (2015). Designing an e-learning curriculum for spelling on the basis of cognitive approach. Contemporary Educational Researches Journal, 5(1), 08–11. https://doi.org/10.18844/cerj.v5i1.9

7 Authors

Nadire Cavus is a professor of Computer Information Systems and director of the Computer Information Systems Research and Technology Centre at the Near East University in Cyprus. She is the chairperson of the Department of Computer Information Systems. She received his Ph.D. in Computer Information Systems from the Faculty of Economics and Administrative Sciences, Near East University, Cyprus in 2007. Her research areas include mobile learning, e-learning, technology-based learning, learning management systems, and technology acceptance and adoption (email: nadire.cavus@neu.edu.tr).

Babatomiwa Omonayajo is a Ph.D. candidate in Computer Information Systems from Near East University in Cyprus. He is currently working on his Ph.D. thesis. His research focuses on machine learning, the Internet of things, technology acceptance and adoption, and e-learning (email: 20212976@std.neu.edu.tr).

Melissa Rutendo Mutizwa is a Master's degree student in Computer Information Systems from Near East University in Cyprus. She is currently working on her Master's thesis. Her research focuses on e-learning, virtual platforms, and technology acceptance and adoption (email: 20204919@std.neu.edu.tr).

Article submitted 2022-09-18. Resubmitted 2022-10-19. Final acceptance 2022-10-22. Final version published as submitted by the authors.

Implementation of RWP and Gauss Markov Mobility Model for Multi-UAV Networks in Search and Rescue Environment

https://doi.org/10.3991/ijim.v16i23.35559

Marwa T. Naser, Ali H. Wheeb(✉)
University of Baghdad, Baghdad, Iraq
a.wheeb@coeng.uobaghdad.edu.iq

Abstract—Future generations of wireless networks are expected to heavily rely on unmanned aerial vehicles (UAVs). UAV networks have extraordinary features like high mobility, frequent topology change, tolerance to link failure, and extending the coverage area by adding external UAVs. UAV network provides several advantages for civilian, commercial, search and rescue applications. A realistic mobility model must be used to assess the dependability and effectiveness of UAV protocols and algorithms. In this research paper, the performance of the Gauss Markov (GM) and Random Waypoint (RWP) mobility models in multi-UAV networks for a search and rescue scenario is analyzed and evaluated. Additionally, the two mobility models GM and RWP are described in depth, together with the movement patterns they are related with. Furthermore, two-simulation scenarios conduct with help of an NS-3 simulator. The first scenario investigates the effect of UAV Speed by varying it from 10 to 50 m/s. the second scenario investigates the effect of the size of the transmitting packet by varying it from 64 to 1024 bytes. The performance of GM and RWP was compared based on packet delivery ratio (PDR), goodput, and latency metrics. Results indicate that the GM model provides the highest PDR and lowest latency in such high mobility environments.

Keywords—UAV, UAV network, emergency scenario, GM, RWP

1 Introduction

Future UAV technology is viewed as a revolution in civil infrastructure because of its low cost, reduced risks, and quick deployment. UAVs are algorithm-controlled, non-human flying nodes that do not need human interaction to move. Because of the integrating features of many electronics devices, UAVs are appropriate for mission-critical applications requiring reliable communication [1]. As seen in Figure 1, UAV networks come in two different forms. The UAV is connected to a satellite or a grounded base station through a single-UAV network. A multi-UAV network links several UAVs as well as a satellite or terrestrial base station. The UAVs in a multi-UAV network can be flexibly arranged in different topologies at any time. The con-

nection between both the UAV and the ground base station is known as the UAV/BS link, whereas the connection between the UAV is known as the UAV/UAV link. [2].

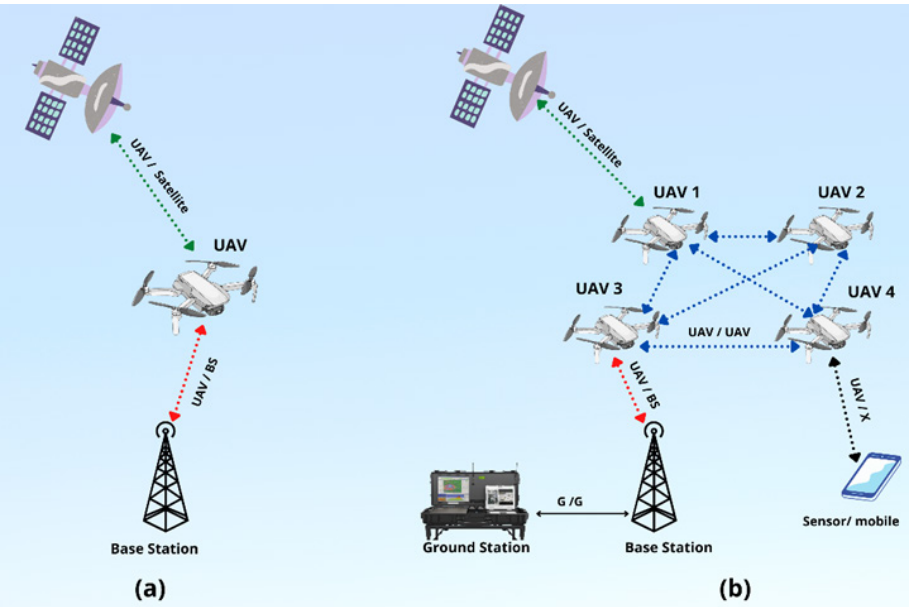


Fig. 1. (a) Single-UAV network (b) Multi-UAV network

New military and civilian applications including battel filed, surveillance, infrastructure inspection, remote sensing ,smart farming, traffic monitoring, and search rescue and missions have been made possible by these innovative flying UAVs [3][4] [5]. Furthermore, UAVs are capable of providing temporary communication links in crises, disasters, inaccessible places, and areas with poor satellite signal coverage [6]. For instance, UAV communication may be used in search and rescue operations when normal communication infrastructure is broken and it is challenging to establish infrastructure in a short amount of time. This is because they are easily adaptable and configured with ad-hoc UAV networks [7][8]. Although UAV enable new applications through their ad hoc networks and flying features, several challenges must be overcome, including routing protocols, infrastructure design, and mobility models[9]. There has been an increase in the quantity of literature on routing protocols, mobility models, and communication standards in recent years. Mobility patterns are crucial in the design of UAVs due to dynamic topological change, fast flight speeds, and often disrupted or disconnected links [10].

Although mobility models play a significant role in the functioning of the UAV network, most research has used 2-D mobility models. For simulating node mobility in 3D, only a few simulator tools are available. As a result, this paper presents an evaluation and performance analysis of Multi-UAV networks using 2D and 3D mobility models. In particular, GM and RWP mobility models are being evaluated for use

with UAVs in search and rescue situations. The NS-3.32 simulator was used to mimic the performance of UAVs under real-world conditions in search and rescue scenarios.

The rest of the article is structured as follows: Section two describes UAV Mobility Models. Section three, Methodology and Simulation Setup, discusses the simulation platform, settings, scenarios, and performance metrics utilized in the research study. Section four of the Result Analysis provided simulation results in the format of tables and graphs. Finally, in section five, the conclusion and future work were drawn.

2 Mobility models for UAVs

A mobility model is a set of guidelines that control how a mobile node moves. Additionally, it controls how a node's location, acceleration, and speed change over time. In order to simulate the development of new routing or communications algorithm and procedures, these mobility models are necessary. Although several UAV mobility models have been proposed thus far, their movements are motivated by particular applications and circumstances [11].

2.1 Gauss Markov (GM)

Liang and Haas were the ones who initially proposed the Gauss-Markov (GM) Mobility Model. [12]. The requirement for a more realistic model, where a node, for instance, may progressively accelerate, slow down, or turn, is what motivated GM model. Gaussian equations, which incorporate Gaussian random noise and average speed and direction, are used to relate a UAV's current speed and direction to its previous movement. [13]. The following formulae can be used to determine the direction and speed of a UAV.

$$S_t = \alpha S_{t-1} + (1-\alpha)S' + \sqrt{(1-\alpha^2)}Sx_{t-1} \quad (1)$$

$$D_t = \alpha D_{t-1} + (1-\alpha)D' + \sqrt{(1-\alpha^2)}Dx_{t-1} \quad (2)$$

Where, S_t and D_t are the speed and direction at time instant t, S' and D' are the mean speed and mean direction, while α is a memory level parameter with value between $0 < \alpha < 1$.

The amount of dependence on previous speed and direction is controlled by α parameter. The model is deemed to exhibit time dependency as a result. The speed and direction of a specific UAV is estimated at a predetermined moment t. After the UAV flying within this direction and at that speed for a fixed amount of time T, the speed and direction are once more calculated. The direction of movement of the UAV is compelled to reverse 180 degrees once it leaves the simulation field's boundaries. It prevents the UAVs from flying close to the edge of the simulation area. Figure 2 is an example of a UAV trajectory using the GM model.

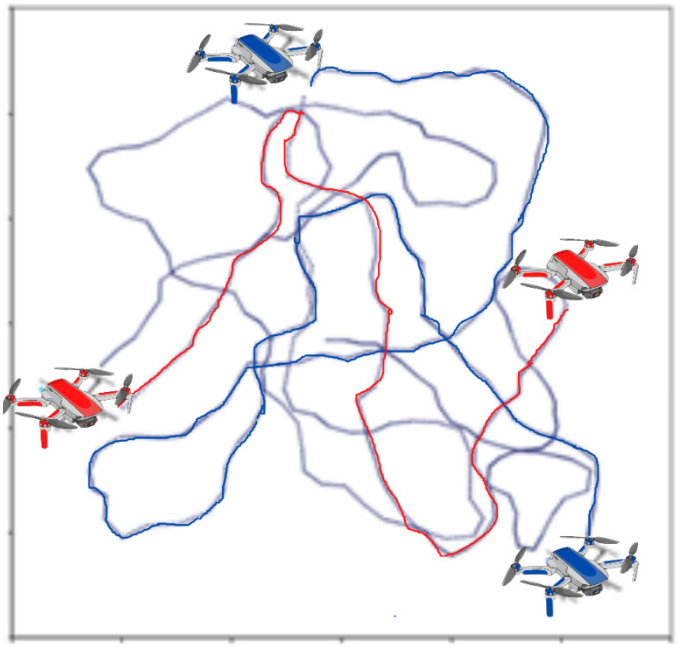


Fig. 2. Example of UAV trajectory in GM model

GM model have adopted for several UAVs application. A 3D geometry model for air-to-ground channels is proposed. Meanwhile, to construct dynamic trajectories, the GM mobile model is used [14]. A mobile edge-computing network with an UAV placed on it investigated, where each TU's mobility is controlled by a GM random model, and the UAV conducts computing tasks that have been allocated from mobile terminal users (TUs). [15].

2.2 Random way point (RWP)

The Random Waypoint Mobility (RWP) is memory less model had come up first by Johnson and Maltz [16]. The first deployment of UAVs in this model's simulation region is random, and each UAV is autonomous. The RWP model operates as follows: Initially, a UAV chooses a destination and starts to flying in that direction in a straight trajectory with a fixed randomized velocities from [0, Vmax]. When a UAV reaches the designated target, it pauses for a period of time known as the pause time T_{pause}. The UAV starts to proceed to a new destination with a real self-direction and speed after the pause period is over. [17]. The two crucial parameters that control the mobility behavior of UAVs in the RWP model are T_{pause} and V_{max}. Figure 3 shows the UAV trajectory using RWP model [18].

Several application of UAV have used RWP model. To explore how UAV mobility affects communication systems and physical layer security, it is believed that UAV will adhere to the RWP model. [19]. In a decode-and-forward (DaF) wireless system

scenario, an intelligent reflecting surface (IRS) would be used to facilitate communication between a UAV and a ground station (GS). In particularly, the UAV operates in a dynamic urban environment at low altitudes in accordance with RWP. [20].

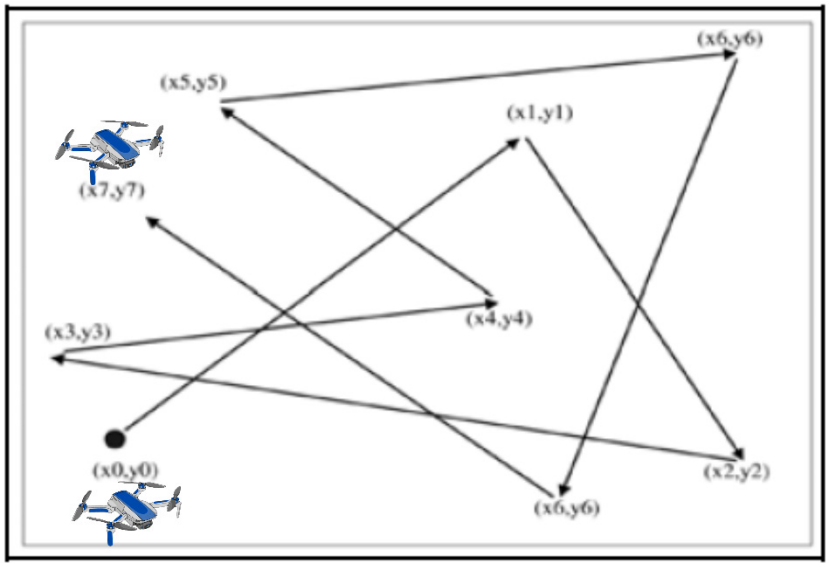


Fig. 3. Example of UAV trajectory in RWP model

2.3 Mobility models and UAVs application

Table 1 present a summary of feasible mobility models for UAV application scenario. Obviously, each UAV scenario required different type of Mobility models [18].

Table 1. A summary of application for UAV and the required mobility models

Application	Mobility models	characterization
Search and Rescue mission	GM RWP	UAV search Randomly on specific area of mission
Urban and Traffic monitoring	MG	UAV make a surveillance in the streets of city
Agriculture Management	PPRZM	UAV operations in agricultural sectors
Sensing Environment	Static	UAVs function as base stations with sensing.
Patrolling	DPR	Mission in real-time with understanding of crucial regions

3 Methodology and simulation set up

3.1 Search and rescue environment

When a rectangular search zone is clearly defined, search and rescue operations frequently follow a simple scan plan created from GM Model. Whenever a randomized search method is necessary, GM model may duplicate a search operation in a clearly specified area regardless of the absence of collision awareness. [21]. When a UAV enters the region, GM has a realistic teleportation feature with 3D mobility. When the UAV leaves the region, each UAV must wait a certain amount of time before re-entering. We want assured delivery and the highest delay tolerance in emergency search situations. In our simulation, we assumed that all UAVs remained inside the mission area.

3.2 Simulation setup

The simulation step was completed with the help of the well-known NS-3.35 simulator [22]. A UAV node participating in a data packet transport might act as the end destination or as a multi-hop routing. Table 2 has more information on configuring the simulation settings.

Table 2. Simulation setup

No	Parameter	Value
1	Network Simulator	Ns-3.32
2	Simulation Area	3600*2400 meter
3	Simulation time	600 sec
4	MAC Protocol	IEEE802.11b
5	Mobility model	GM, EGM, RWP
6	UAV Altitude	100 meter
7	UAV Speed	10-20 m/s
8	UAV Density	50 UAV
9	UAV transmission range	300 meter
10	Routing protocol	AODV

3.3 Simulation scenario

This study conduct two simulated scenarios to evaluate the behavior of the GM and RWP models in multi-UAV networks with search and rescue environments. The following scenarios were simulated:

1. The first scenario investigates the effect of mobility by varying UAV velocity from (10, 20, 30, 40, 50) m/s over GM and RWP models.
2. The second scenario investigate the effect of data packet by varying UAV transmitted packet size (64, 128, 256, 512, 1024) bytes over GM and RWP models.

3.4 Performance metrics

We measured performance metrics to compare effectiveness of mobility model in this mobile and data packet scenarios.

The Packet Delivery Ratio (PDR) displays the proportion between both the number of data packets broadcast by the source and those that are received at the destination. The following equation serves as the basis for measuring this metric.

$$PDR = \frac{R_{pkt}}{T_{pkt}} \tag{3}$$

Where R_{pkt} the total data packet received by destination UAV. T_{pkt} the data packet transmitted by source UAV.

Goodput is the total number of data packet received by destination UAV during simulation divide by the simulation time. Goodput is measured by bit/sec and can be express by the following equation.

$$Goodput = \frac{\sum R_{pkt}}{T_{sim}} \tag{4}$$

Where, T_{sim} is the simulation time.

Latency is the total time taken be data packet to transmit from source to destination UAV. Latency is measured by second; the mobility model with minimum latency is required for real-time application. This metrics can be calculated using the following equation.

$$Latency = T_{des} - T_{src} \tag{5}$$

Where T_{des} is the time of reach the data packet destination UAV, T_{src} is the time of transmit the packet from source UAV.

4 Result analysis

4.1 Effect of UAV speed on the behavior of mobility models

Figure 4 show the PDR performance of M-UAV network under RWP and GM mobility models. By varying the speed of UAVs from 10 to 50 m/s it is possible to see the degradation in the performance. For example, GM model has PDR of 98% with UAVs speed 10m/s, while it has PDR of 95% at speed of 50m/s. the same trend can be observed for RWP. This is due to high mobility of UAV, which leads to change network topology rapidly and fails links to deliver packets. Both models only have the same PDR rating of 98% at a UAV speed of 20 m/s. According to the graph in Figure 4, the performance of the GM model is better than the RWP model.

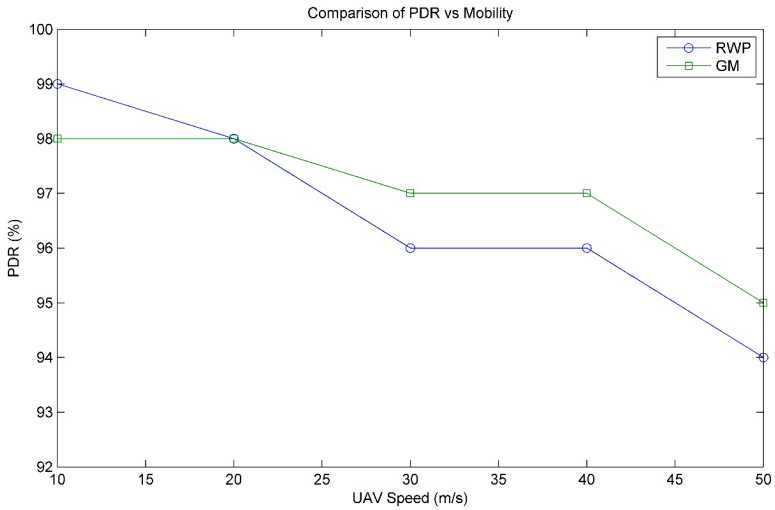


Fig. 4. PDR vs UAV speed

The goodput performance of M-UAV network under the GM and RWP models is illustrates in Figure 5. Similar to PDR performance, when the UAV speed increases the goodput performance dropped. This is due the increase in the number of dropped packet. We can notice that GM models provide better goodput performance as compared to RWP model. GM model archive maximum goodput at UAV speed of 10m/s. on the other hand, RWP model present slightly better goodput than GM model at UAV speed 30 m/s.

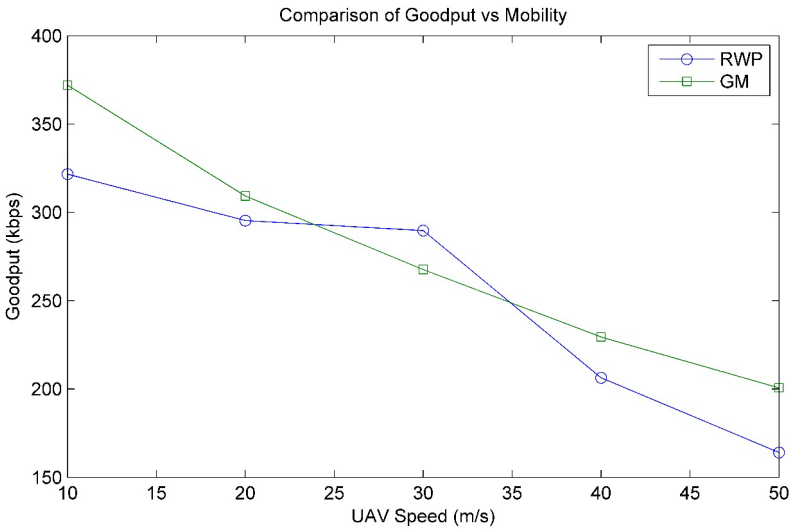


Fig. 5. Goodput vs UAV speed

Figure 6 display the Latency performance of M-UAV network under GM and RWP Mobility models. As the UAV speed increase from 10 to 50 m/s the latency increase in M-UAV network because the high speed of UAVs leads to breakage the link between UAVs and route discovery. Form graph in Figure 6 it can be seen that performance of RWP model is slightly outperform GM model at 40 and 50 m/s UAV speed respectively. While GM model achieve the minimum latency at 20 m/s UAV speed. Real time application like search and rescue operation require minimum latency.

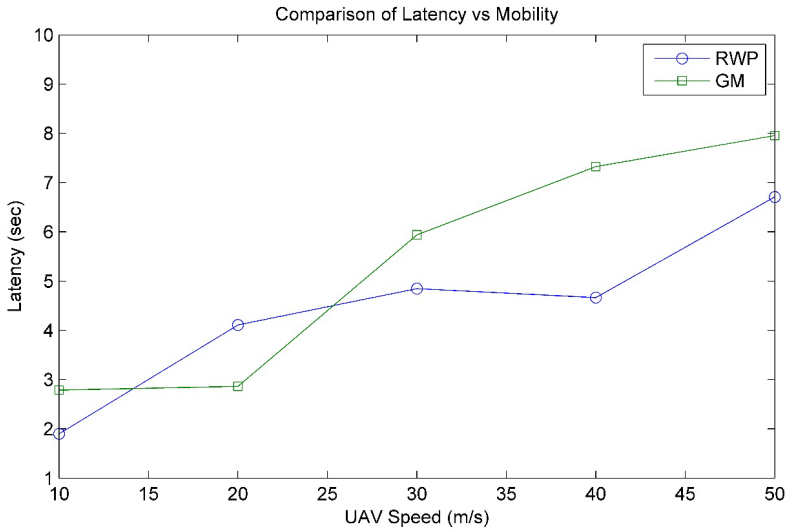


Fig. 6. Latency vs UAV speed

4.2 Effect of UAV packet size on the behavior of mobility models

The discussion on the impact of packet size starts with Figure 7, which depicts PDR for an M-UAV network. Consider the small packet size at value of 64 byte both GM and RWP have the high PDR around 98%. As the packet size increase, we can notice that GM present better performance as compared to RWP model. Further, the GM model show smooth behavior with little change in PDR due to smooth change in UAV trajectory. In addition, it is evident from Figure 7 that the performance of M-UAV network influence by the varying of Packet size.

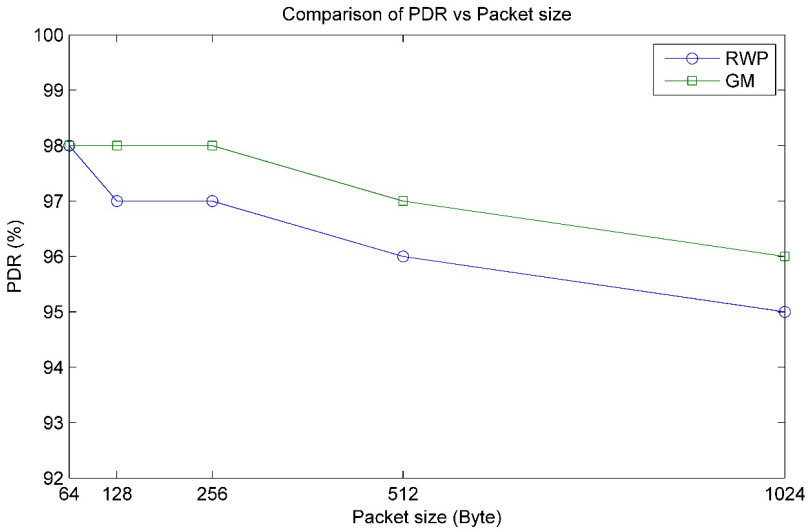


Fig. 7. PDR vs UAV packet size

Figure 8 display the goodput performance of M-UAV network under GM and RWP models. Form Figure 8 it notice that the good put of M-UAV network increase as the size of UAV packet increases from 64 to 1024 byte. GM model present a higher goodput value and a clear superiority in performance as compared to RWP model. On the other hand, RW model show poor behavior due to sudden change in mobility pattern. Further, GM models achieve maximum goodput with value of 376 kbps at UAV packet size 1024byte.

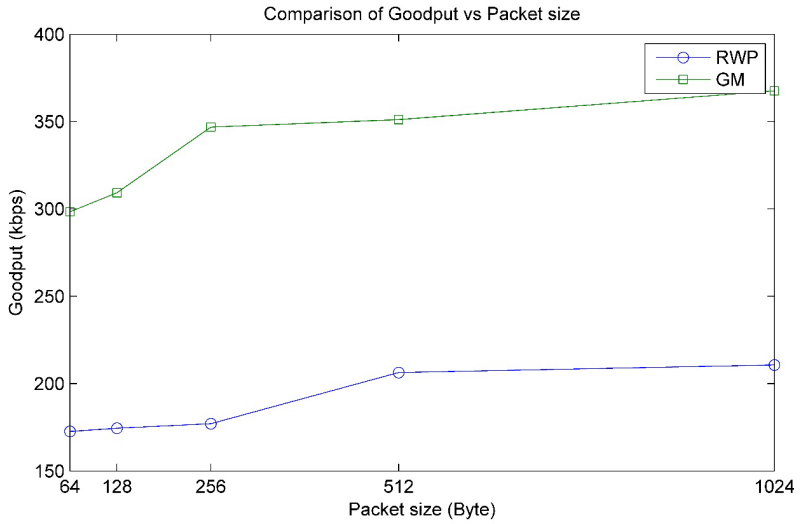


Fig. 8. Goodput vs UAV packet size

Figure 9 present the Latency performance of M-UAV network under GM and RWP Mobility models. As the UAV packet size increase from 64 to 1024 byte the latency increase in M-UAV network because if the UAV cannot transmit the data packet it will be enter queue and this leads to increase latency. Form graph in Figure 9 it can be seen that performance of GM model is slightly outperform RWP model at UAV packet size of 512 and 1024 byte respectively. Only at 256 byte RWP model has less latency than GM model. Therefore, GM model is suitable for emergency application of UAV Network.

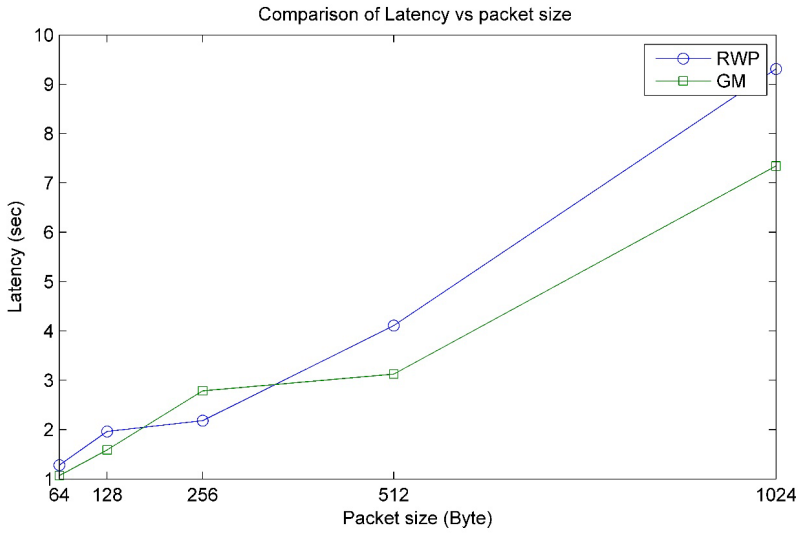


Fig. 9. Latency vs UAV packet size

5 Conclusion

In this paper, we have examined GM and RWP Mobility models in order to choose the best of them for search and rescue mission through a Multi-UAV network. We compared effectiveness of mobility models based on PDR, goodput, and latency metrics. In addition, two simulation scenarios conduct by varying the UAV speed and size of Transmission packet. GM showed the highest PDR and the highest goodput as compared to RWP in the two scenarios through the Multi-UAV network. Further, GM provide the lowest latency with varying packet size. On the other hand, RWP present poor behavior in such high mobility environments due to its random nature and sudden change in direction and speed of UAVs. Latency metrics for GM and RWP mobility models effected by UAV speed due to the time dependent and random component of both models. Results indicate that a GM models can significantly improve the performance for the search and rescue mission in Multi-UAV network. In future work, modified GM mobility models can be considered in smart city environment.

Further, the UAV communication protocols effect on mobility models need to be consider by researcher.

6 References

[1] M. M. Mowla, M. A. Rahman, and I. Ahmad, "Assessment of Mobility Models in Unmanned Aerial Vehicle Networks," *5th Int. Conf. Comput. Commun. Chem. Mater. Electron. Eng. IC4ME2 2019*, pp. 1–4, 2019, https://doi.org/10.1109/IC4ME247184.2019.9036678

[2] A. H. Wheeb, R. Nordin, A. A. Samah, M. H. Alsharif, and M. A. Khan, "Topology-Based Routing Protocols and Mobility Models for Flying Ad Hoc Networks : A Contemporary Review and Future Research Directions," *Drones, MDPI*, vol. 6, no. 1, pp. 1–28, 2022. https://doi.org/10.3390/drones6010009

[3] A. Utsav, A. Abhishek, P. Suraj, and R. K. Badhai, "An IoT Based UAV Network for Military Applications," *2021 Int. Conf. Wirel. Commun. Signal Process. Networking, WiSPNET 2021*, pp. 122–125, 2021, https://doi.org/10.1109/WiSPNET51692.2021.9419470

[4] B. Al-Rami, K. M. A. Alheeti, W. M. Aldosari, S. M. Alshahrani, and S. M. Al-Abrez, "A New Classification Method for Drone-Based Crops in Smart Farming.," *Int. J. Interact. Mob. Technol.*, vol. 66, no. 8, 2022. https://doi.org/10.3991/ijim.v16i09.30037

[5] P. Zimroz *et al.*, "Application of UAV in search and rescue actions in underground mine—A specific sound detection in noisy acoustic signal," *Energies*, vol. 14, no. 13, pp. 1–21, 2021, https://doi.org/10.3390/en14133725

[6] H. S. Munawar, F. Ullah, S. Qayyum, S. I. Khan, and M. Mojtahedi, "Uavs in disaster management: Application of integrated aerial imagery and convolutional neural network for flood detection," *Sustain.*, vol. 13, no. 14, 2021, https://doi.org/10.3390/su13147547

[7] A. H. Wheeb, "Flying Ad hoc Networks (FANET): Performance Evaluation of Topology Based Routing Protocols," *Int. J. Interact. Mob. Technol.*, vol. 16, no. 4, pp. 137–149, 2022, https://doi.org/10.3991/ijim.v16i04.28235

[8] A. R. Ragab, "A new classification for ad-hoc network," *Int. J. Interact. Mob. Technol.*, vol. 14, no. 14, pp. 214–223, 2020, https://doi.org/10.3991/ijim.v14i14.14871

[9] A. H. Wheeb and M. T. Naser, "Simulation based comparison of routing protocols in wireless multihop ad hoc networks," *Int. J. Electr. Comput. Eng.*, vol. 11, no. 4, pp. 3186–3192, 2021, https://doi.org/10.11591/ijece.v11i4.pp3186-3192

[10] P. A. Regis, S. Bhunia, and S. Sengupta, "Implementation of 3D obstacle compliant mobility models for UAV networks in ns-3," *ACM Int. Conf. Proceeding Ser.*, vol. Part F1321, pp. 124–131, 2016, https://doi.org/10.1145/2915371.2915384

[11] A. Chriki, H. Touati, H. Snoussi, and F. Kamoun, "FANET: Communication, mobility models and security issues," *Comput. Networks*, vol. 163, p. 106877, 2019, https://doi.org/10.1016/j.comnet.2019.106877

[12] B. Liang and Z. J. Haas, "Predictive distance-based mobility management for multidimensional PCS networks," *IEEE/ACM Trans. Netw.*, vol. 11, no. 5, pp. 718–732, 2003, https://doi.org/10.1109/TNET.2003.815301

[13] J. D. M. M. Biomo, T. Kunz, and M. St-Hilaire, "An enhanced Gauss-Markov mobility model for simulations of unmanned aerial ad hoc networks," *2014 7th IFIP Wirel. Mob. Netw. Conf. WMNC 2014*, 2014, https://doi.org/10.1109/WMNC.2014.6878879

[14] Y. Li *et al.*, "Air-to-ground 3D channel modeling for UAV based on Gauss-Markov mobile model," *AEU - Int. J. Electron. Commun.*, vol. 114, p. 152995, 2020, https://doi.org/10.1016/j.aeue.2019.152995

[15] Q. Liu, L. Shi, L. Sun, J. Li, M. Ding, and F. S. Shu, "Path Planning for UAV-Mounted Mobile Edge Computing with Deep Reinforcement Learning," *IEEE Trans. Veh. Technol.*, vol. 69, no. 5, pp. 5723–5728, 2020, https://doi.org/10.1109/TVT.2020.2982508

[16] A. Boukerche, "A performance comparison of routing protocols for ad hoc networks," *Proc. - 15th Int. Parallel Distrib. Process. Symp. IPDPS 2001*, pp. 1940–1946, 2001, https://doi.org/10.1109/IPDPS.2001.925188

[17] A. H. . N. A. S. Wheeb, "Performance Analysis of OLSR Protocol in Mobile Ad Hoc Networks," *Int. J. Interact. Mob. Technol.*, vol. 16, no. 1, pp. 106–119, Jan. 2022, https://doi.org/10.3991/ijim.v16i01.26663

[18] A. Bujari, C. E. Palazzi, and D. Ronzani, "FANET application scenarios and mobility models," *DroNet 2017 - Proc. 3rd Work. Micro Aer. Veh. Networks, Syst. Appl. co-located with MobiSys 2017*, pp. 43–46, 2017, https://doi.org/10.1145/3086439.3086440

[19] R. Ruby, B. M. ElHalawany, and K. Wu, "Impact of UAV mobility on physical layer security," in *2021 17th International Conference on Mobility, Sensing and Networking (MSN)*, 2021, pp. 287–295. https://doi.org/10.1109/MSN53354.2021.00053

[20] O. S. Badarneh, M. K. Awad, S. Muhaidat, and F. S. Almehmadi, "Performance Analysis of Intelligent Reflecting Surface-Aided Decode-and-Forward UAV Communication Systems," *IEEE Syst. J.*, 2022. https://doi.org/10.1109/JSYST.2022.3178327

[21] D. A. Korneev, A. V. Leonov, and G. A. Litvinov, "Estimation of Mini-UAVs Network Parameters for Search and Rescue Operation Scenario with Gauss-Markov Mobility Model," *2018 Syst. Signal Synchronization, Gener. Process. Telecommun. SYNCHROINFO 2018*, pp. 1–7, 2018, https://doi.org/10.1109/SYNCHROINFO.2018.8457047

[22] L. Campanile, M. Gribaudo, M. Iacono, F. Marulli, and M. Mastroianni, "Computer network simulation with ns-3: A systematic literature review," *Electron.*, vol. 9, no. 2, pp. 1–25, 2020, https://doi.org/10.3390/electronics9020272

7 Authors

Marwa T. Naser is with University of Baghdad, Baghdad, Iraq.

Ali H. Wheeb is an Associate Professor at the College of Engineering, University of Baghdad since 2014. His fields of research interest are wireless networks, WSN, IoT, mobile ad hoc networking (MANET), flying ad hoc networks (FANET), UAV mobility models, UAV networks, routing protocols, transport Protocol, and networking simulation tools Ns-2 & NS-3. Further, he publishes 12 research papers in high-reputation journals. Additionally, Ass. Prof. Ali serve as a reviewer in several journals and conferences and reviewed 210 papers until now. Further, Asst. prof. Ali pointed as Editorial Board Member in several international journals. Moreover, he was selected as a program committee member, Technical Committee Member, and chair at several international conferences (Email: a.wheeb@coeng.uobaghdad.edu.iq).

Article submitted 2022-09-24. Resubmitted 2022-10-16. Final acceptance 2022-10-17. Final version published as submitted by the authors.

Knowledge and Perceptions About Mobile E-Commerce Technologies in Kosovo

https://doi.org/10.3991/ijim.v16i23.36211

Jusuf Qarkaxhija(✉), Blerta Prevalla, Shpëtim Latifi
Faculty of Computer Sciences, AAB College, Pristina, Kosovo
jusuf.qarkaxhija@universitetiaab.com

Abstract—The enormous increase of online shopping, sales and online orders is disproportionate to the knowledge of the users of these services. The purpose of this paper is to understand how online shopping and orders are perceived by people who are directly or indirectly involved in online e commerce services. The study utilized questionnaires in the collection of data. Data was analyzed using Excel and percentages. Based on the results of the conducted study, it was revealed that very few people know how to distinguish between online shopping and online orders. The same hypothesis can be used to explain what e-commerce is.

Keywords—online shopping, e commerce, online orders, commerce, internet, services, pandemic

1 Introduction

The Internet is a community of millions of interconnected local area networks, thus creating the global communication network. Thus, the Internet is a network of networks [1]. This network is a distributed system and is not owned or administered by anyone. It can also be said that the Internet is a global space that enables the exchange of information in large quantities, around the world and at a high speed [2]. There are a number of services on the Internet that are constantly being added. Some of these services are [3]:

- World Wide Web (WWW)
- Electronic mail (E - mail)
- File forwarding (FTP)
- Searching for information
- Conversations and discussion groups
- Organizing web pages
- Data encryption
- Buying and selling (e-commerce), etc.

The Internet has been adopted much faster than previous technologies. For instance, it took radio 38 years to reach 50 million users, personal computers took 16 years, television 13 years, whereas the Internet took only 4 years to reach that figure [4], [5].

Many people think that the Internet, e - business and e - commerce are the same thing, but this is not the case. Internet is a tool, e-commerce is simply a transaction (sale or purchase) through the Internet or other electronic devices, while e-business is the integration of people, processes, and technology to run the business [6]. E-commerce (selling and buying through the Internet or e-business) is part of e-business that was discovered by Michael Aldrich in 1979 [7]. E-commerce from the consumer's point of view, means the purchase of products or services through the website (amazon.com, ebay.com, etc.), while e-commerce, from the business's point of view offers consumers the right way to develop business through powerful websites and online databases [8], [9].

E-commerce, depending on the degree of digitalization can take several forms of: sold product, payment process, and method of distribution. The product can be physical (tangible) or digital, the payment process can be physical or digital, and the delivery method can be physical or digital. These alternatives create eight cubes, each of which has three dimensions. In traditional business, all three dimensions are physical, and in pure e - commerce all dimensions are digital. All other cubes make up a combination of physical and digital dimensions. If there is at least one dimension digital, then the process is considered partly e - commerce. For example, buying jeans from an online company is partial e-commerce because the goods are physically distributed. However, buying an e-book (electronic book) on amazon.com or anywhere else is a pure e-commerce process because the product is distributed, paid for and transferred digitally [10].

So, as a basic prerequisite for online commerce, there should be Internet penetration in those countries, and in the case of Kosovo penetration according to Internet World statistics (2021) is 88.8%, which is higher than any country in the region but also more than some European Union countries, for example Austria (87.6%), Czech Republic (87.7%), etc. As a result of the pandemic and the high rate of Internet penetration, online shopping and online orders have recently started to be widely used in Kosovo, but online orders are used much more [11]. Online orders can be easily realized, as most businesses have profiles on social networks on behalf of their businesses. Most online orders in Kosovo are related to food products, so payments are made physically after receiving the product, while to order a product (whatever) outside Kosovo, it cannot be sent to Kosovo without paying it first, so this process is transformed in online shopping. From what it was discussed, it can be noticed that online ordering is a process which is not about e-commerce, but simply a trade where social networks are used such as Facebook or Instagram, etc. [12] and upon arrival payment is made. Electronic payment through the POS device (point of sales) [13] – [15] can also be included in this process.

1.1 Related research

This paper is based on research, but the literature used has been sufficient to show the essence of why it was realized. Through the literature it was seen as important to

show some things like for example that e-business and e-commerce are not the same, and this has been done by Sweeney [6]. Then it was seen important to also show that e-commerce is more complex than the name itself, so to clarify that it is divided into partial and pure or complete e-commerce, and this can be seen from the group of authors headed by [10]. From this literature of Turban (2015) [10] the difference between online shopping and online orders can be seen for which this research is conducted.

Then from the statistics of Internet World Statistics (2021) it can be noticed that the penetration of the Internet in Kosovo is extremely large, which has affected the tremendous growth of online shopping, sales and orders in Kosovo. Several links have also been used to show how some businesses use social media to enable customers to place messages online (Facebook).

1.2 Purpose of study

We are living in a time where the use of the Internet also dictates the way of living, operating, and doing business. The use of the internet for buying and selling online started a long time ago, but in the period of the pandemic it was the only economic sector in many countries of the world which has had growth. This sector has worked quite well in many companies in Kosovo, where those who had sufficient knowledge of e-commerce had quite large revenues. Even before the pandemic but even now many trades online, but few of those who buy, sell or order can distinguish between online shopping and online ordering. In general, there are also very few of them who know how to distinguish between pure e-commerce and partial e-commerce. Hence, the enormous increase of online shopping, sales and online orders is disproportionate to the knowledge of the users of these services. Therefore, the purpose of this paper is to validate through the questionnaire the hypothesis that, although most people are directly or indirectly involved in online trading services, very few of them are theoretically aware of what they are accomplishing.

2 Research methodology

2.1 Data collection tool

The research was conducted through a questionnaire designed specifically for this issue, as the group of authors considered it very necessary to look at what online buyers think and whether they can distinguish between online shopping and ordering. The questionnaire was compiled based on the experience of the team, from the lectures held at the faculty from the course "E - commerce" (master program) and another course called "Electronic Business" (bachelor program), as well as based on extensive discussions in various institutions and on social media. Before the questionnaire was finalized, it was discussed and evaluated with experts and collaborators from the Primorska University in Kopri Slovenia, the University of Applied Sciences in Ferizaj, the University Fehmi Agani in Gjakova and the University Johannes Kepler of Linz in

Austria. The questionnaire was prepared through the software, so that the data were processed automatically.

2.2 Data collection procedure

In order to obtain accurate results that correspond to the purpose of the paper, the created questionnaire is designed in four sections or with four levels of protection of the results, so that the greatest possible filtering of records it is done. The first two questions of the questionnaire are related to demographic factors, such as gender and age, and the third question is related to whether or not the respondent's work. After the fourth question, the first filtering or selection is done, where those who declare that they have no knowledge about online shopping and orders, do not proceed to the other questions. The next filtering of participants occurs after the fifth question, where those who declare that they do not distinguish online shopping and orders do not proceed further. The last filtering of the participants in the survey occurs in the sixth question, where those who state that the difference is not in the method of payment (which it really is) then they cannot proceed to the last two questions. In the last question the respondents had the opportunity to answer by choosing more than one option, while the purpose of the eighth question was to get information on how much they understand exactly what commerce is.

2.3 Participants

This research was conducted by the team of the Dean's Office of the Faculty of Computer Science under the guidance of the author of the paper. The questionnaire was answered by 89 respondents. The companies with which the faculty has cooperation agreements have also provided great assistance in research. Everyone from the team is first trained on the purpose of the survey so that participants can be filtered according to the sections into which the questionnaire is divided. Many colleagues, students and Internet users were also interviewed.

2.4 Analysis

All obtained results will be presented in tables (except the seventh question) with numerical values but also with percentages and will be commented. The seventh question will be presented graphically through the Excel program [16]-[18], and will also be commented.

3 Results

The research conducted consists of a total of eight questions and the respondents could chose more than one option in some of the questions. The questionnaire was answered by 89 respondents, and it was considered that this number is more than enough to gain valuable results in terms of knowledge that Internet users have about

the difference between online shopping and online orders, and whether these or any of those could be e - commerce.

The first two questions were of a demographic nature, while the first had to do with the gender of the respondents. There were two options in the answer: Male or Female, and out of 89 respondents surveyed, most were male, i.e., 66 or 74.2% while females were 23 or 25.8%.

Table 1. Gender of the respondents

Question 1	Male	Female
Gender	66	23
	74.2 %	25.8 %

The second question which was also of a demographic nature had to do with the age of the respondents and out of the three questions asked the answers were as follows: 32 participants or 36% were aged under 30 years, aged 30 to 50 were 40 participants or 44.9% of the total, while over the age of 50 were 17 or 19.1%.

Table 2. Age of the respondents

Question 2	Under 30 years	30 to 50 years	Over 50 years
Age	32	40	17
	36 %	44.9 %	19.1 %

The results obtained from the first two questions prove that men are the most frequent Internet users in Kosovo (the first question) and the age of the most frequent users is between 30 and 50 years. These results are close to the statistics on Internet use in Kosovo conducted by the Kosovo Agency of Statistics, 2020 [19].

In the third question which was whether the respondents work, the answers were as follows: the majority of them answered with a positive answer Yes, i.e.,80 or 89.9% of them, while 9 of them or 10.1% answered with a negative answer No. Results are summarized in Table 3.

Table 3. Employment

Question 3	Yes	No
Do you work?	80	10
	89.9 %	10.1 %

Even from the answers to the third question it can be understood that the respondents had good knowledge on how to use the Internet.

The fourth question was how much the respondents know about online shopping and online orders, and their answers were as follows: 87 or 97.8% stated that they have knowledge while 2 of them or 2.2% did not have knowledge. After this question, the first selection or filtering of the participants was done, where those who declared that they have no knowledge do not continue in the subsequent questions. This was done

with the intention that if anyone has no knowledge about online shopping and online orders, then there is no reason for them to respond as the results obtained would not be credible. So, in the next question (fifth) 87 respondents will continue to participate. Results are summarized in Table 4.

Table 4. Knowledge of online shopping and online ordering

Question 4	Yes	No
Do you have knowledge about online shopping and online ordering?	87	2
	97.8 %	2.2 %

In the fifth question that had to do with the respondents' perceptions whether online shopping differs from online orders, the answers were as follows: with Yes answered 64 respondents or 73.6%, with No 17 or 19.5% and 6 or 6.9% stated that they have no idea about the issue addressed. Results are summarized in Table 5.

Table 5. Difference between online shopping and online orders

Question 5	Yes	No	I have no idea
Do you think online shopping differs from online ordering?	64	17	6
	73.6 %	19.5 %	6.9 %

After this question, the second selection or filtering of participants is conducted. In the next question (sixth) the research will continue with the participation only those who stated that they distinguish online shopping with online orders, i.e., a total of 64 respondents. This is done with the intention that if anyone does not have accurate knowledge of this difference between these two kinds then the answers to the following questions cannot be completed as the questions are interrelated so that to get the most accurate result.

Where do you think online shopping and online orders differ, was the sixth question and from which these answers were obtained: 37 or 57.8% said that they differ in the method of payment, in their difference regarding transportation stated 8 or 12.5% and other19 or 29.5%. After the answers to this question, the third and last filtering of the respondents is done and in the following two questions continue those who said that online shopping and orders differ from the method of payment (so that is correct), that is, 37 respondents in total. Results are summarized in Table 6.

Table 6. Where is the difference between online shopping and orders?

Question 6	Payment method	Kind of transportation	Other
Where do you think online shopping differs from online ordering?	37	8	19
	57.8 %	12.5 %	29.5 %

The answers to this question lead us to the conclusion that, although there are regular Internet and e-commerce users, not everyone understands what they are actually doing.

So, in the seventh question 37 respondents continue to give answers, and who in the question of which transactions you have used so far, have given these answers (have had the opportunity to choose more than one option - graph):

- Online shopping was used by 10 respondents or 27%.
- Online orders were used by 13 respondents or 35.1 %
- Both services were used by 18 respondents or 48.6%.
- None of the services from the above mentioned was declared by only one person who did not use them or 2.7%.

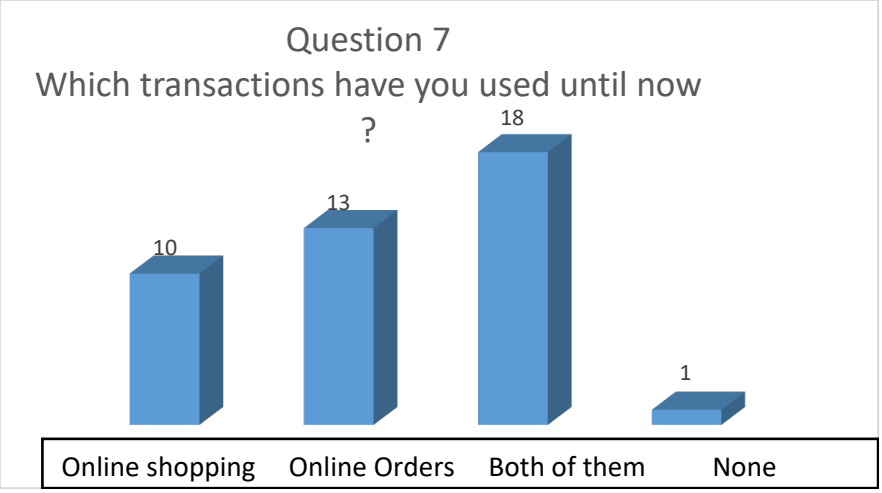


Fig. 1. Transactions used by respondents

The eighth question to which 37 respondents also continued to answer was, which of the options can be called e-commerce: for the option online shopping were declared 21 respondents or 56.8%, for online orders 6 or 16.2%, for the first two options 9 or 24.3% while for neither of them 1 respondent nor 2.7%.

Table 7. Which of the following options can be called e - commerce?

Question 8	Online shopping	Online orders	The first two options	None
Which of these options can be called e - commerce?	21	6	9	1
	56.8 %	16.2 %	24.3 %	2.7 %

Analyzing the results from the last question, it can be said that a little more than half of the remaining respondents or 56.8% really understand what e-commerce which is an unsatisfactory number since the total number of initial respondents were 89, which means that 21/89 = 23.6% have knowledge of e - commerce.

4 Discussion

By analyzing the findings from the questionnaire some conclusions can be made which in addition to confirming the hypotheses raised, are also consistent with some data presented by the Kosovo Agency of Statistics [19]. Initially, it can be said that most of the respondents were male and that the age of Internet users in Kosovo who mostly use the Internet is 30 to 50 years. From this it can be assumed that at this age is the highest number of employees and potentially also those who use the Internet for any electronic transaction [20]-[22].

In addition to the above data, from the answers to the aforementioned questions it can be concluded that although most say that there is a difference between online shopping and online orders, still only 37 respondents out of 89 of the total number answered exactly where the difference is, so 41.6% of the total which leads authors to the conclusion that most do not know where to distinguish online shopping with online orders.

In terms of perception of which of these can be e - commerce, this result was obtained that 23.6% know what this is and based on this it can be concluded that less than a quarter of users know what e – commerce really is. This result corroborates to that of Arante [23] and Pineida [24].

5 Conclusion

Based on all of this it can be concluded that, although the penetration of the Internet in Kosovo and its use is extremely high, still there is much room for improvement regarding knowledge in the theoretical field of Internet services.

The next step in expanding this research is to establish contacts with researchers from the region, so that the data obtained from this research can be compared with data of other countries. From this comparison knowledge about the level of theoretical education in the field of electronic business or e – commerce will be gained.

6 Recommendations

Looking at the data obtained from research and all the opportunities that the Internet offers, i.e., doing business through it, then it is necessary that in pre-university education curricula there are modules that affirm the theoretical aspects of the services offered by the Internet. Also, the companies that provide such services are suggested to name their services more specifically. Perhaps this is an issue that belongs only to experts in the field, but looking at the knowledge, usage, penetration and skills of young people for the Internet, it can be said that practical work should be combined with theoretical learning. Social media as well as numerous television stations should contribute to this regard.

7 References

[1] Fox, R., & Hao, W., (2018) "Internet Infrastructure, Networking, Web Services, and Cloud Computing", CRC Press, pp 27 – 31. https://doi.org/10.1201/9781315175577

[2] Comer, D.E., (2019) "The Internet Book", CRC Press, pp. 107 – 110. https://doi.org/10.1201/9780429447358-10

[3] Tanenbaum, A. (2003) "Computer Networks", Prentice Hall, pp 10 – 20.

[4] Cassidy, A. (2005) "Planning for E-Business Success", St Lucie Press, pp 5 – 15.

[5] Arhin, S., & Santuoh, F. J. (2018). Ethical issues in Cocoa purchasing and transportation. Perspective of Social consumerism with Christian blending from Proverbs 11:1. International Journal of New Trends in Social Sciences, 2(1), 15–24. https://doi.org/10.18844/ijntss.v2i1.3125

[6] Sweeney, S. (2007) "101 Internet Businesses You Can Start From Home", Maximum Press, pp 18 – 50. [Online]. Available: https://books.google.com/books?hl=en&lr=&id=qfFWGvNLWkQC&oi=fnd&pg=PR12&ots=OPEgUGY_55&sig=RsfHaCJ59nx286WZOrbBLL8XUOM [Accessed: Jan, 12, 2022].

[7] Tkacz, E., & Kapczynski, A., (2009) "Internet - Technical Development and Applications", Springer. p. 255. https://doi.org/10.1007/978-3-642-05019-0

[8] Funabashi, M., Grzech, A. (2005) "Challenges of expanding Internet: e-commerce, e-business, and e-government", Springer, pp 181 – 185. [Online]. Available: https://books.google.com/books?hl=en&lr=&id=XpneBwAAQBAJ&oi=fnd&pg=PR10&ots=Xq1lfJteBu&sig=zacm04q0zaRkp-MG08YubAO2hos [Accessed: Nov,22, 2021].

[9] Sorokoumova, E. A., Puchkova, E. B., Cherdymova, E. I., & Temnova, L. V. (2021). Teachers' perspectives on digitalized education and deterrents to the use of digital products in educational processes. *Cypriot Journal of Educational Sciences*, *16*(5), 2677–2689. https://doi.org/10.18844/cjes.v16i5.6356

[10] Turban. E., King. D., Lee. J. K., Liang, T. P., and Turban, D.C., (2015), "Electronic Commerce: A Managerial and Social Networks Perspective 8th Ed.", Springer, pp 7 – 10. [Online]. Available: https://www.academia.edu/11706168/Turban_E_King_D_Lee_J_K_Liang_T_P_and_Turban_D_C_2015_Electronic_Commerce_A_Managerial_and_Social_Networks_Perspective_8th_Ed [Accessed: Nov,6, 2021].

[11] Article of the electronic newspaper Koha.net published on 19.05.2020, [Online]. Available: https://www.koha.net/tech/222378/blerjet-online-rriten-porosite-brenda-bien-ato-nga-jashte/, [Accessed on 06.11.2021].

[12] Porosite, (2021). Retrieved from Facebook (2021), Available at: https://www.facebook.com/porositeOnlinekosove/, [Accessed: nov, 06,2021]

[13] Kundai, O.S., (2017) IRA-International Journal of Education & Multidisciplinary Studies ISSN 2455–2526; 6 (2), 181-190. https://doi.org/10.21013/jems.v6.n2.p5

[14] Aolak, M., Cetin, T., & Cinar, B. (2018). Health And Safety Instructions In The Markets. International Journal of Innovative Research in Education, 5(4), 100–118. https://doi.org/10.18844/ijire.v5i4.3973

[15] Mimoso, M. J., Anjos, M. R., & Teixeira, J. (2018). The right to water as a fundamental right. World Journal of Environmental Research, 8(2), 45–52. https://doi.org/10.18844/wjer.v8i2.3833

[16] Alexander, M., & Kusleika, D. (2016), "Excel 2016 Formulas", Wiley, pp 431 – 441. https://www.wiley.com/en-bo/Excel+2016+Formulas-p-9781119067863

[17] Karim, S., Sandu, N., & Gide, E. (2018). The economic benefits of Cloud-based e-commerce in Indian service SMBs. Global Journal of Information Technology: Emerging Technologies, 8(2), 75–85. https://doi.org/10.18844/gjit.v8i2.3529

[18] Abu-Rumman, A. (2021). Transformational leadership and human capital within the disruptive business environment of academia. World Journal on Educational Technology: Current Issues, 13(2), 178–187. https://doi.org/10.18844/wjet.v13i2.5652

[19] Kosovo Agency of Statistics (2020), pp. 5 – 6. [Online]. Available: https://ask.rks-gov.net/media/5804/anketa-e-p%C3%ABrdorimit-t%C3%AB-teknologjis%C3%AB-informative-komunikimit2020.pdf, [Accessed: nov, 9, 2021].

[20] Chivu, R. G., Stoica, I., Orzan, M.-C., & Radu, A.-V. (2018). New trends in marketing mix strategies for digital consumer behaviour. New Trends and Issues Proceedings on Humanities and Social Sciences, 5(2), 89–95. https://doi.org/10.18844/prosoc.v5i2.3658

[21] Sandu, N., & Gide, E. (2019). The economic benefits of cloud-based E-commerce in Indian service small to medium businesses (SMBs). Global Journal of Computer Sciences: Theory and Research, 9(1), 21–31. https://doi.org/10.18844/gjcs.v9i1.4141

[22] Hasanov, N., & Akbulaev, N. (2020). Innovative development of key sectors of economy based on the creation of technological parks in the Republic of Azerbaijan. New Trends and Issues Proceedings on Advances in Pure and Applied Sciences, (12), 44–56. https://doi.org/10.18844/gjpaas.v0i12.4986

[23] Arante, R. B. (2018). Effectiveness of the improvised logic gates simulator in basic digital electronics instruction. International Journal of Learning and Teaching, 10(4), 367–375. https://doi.org/10.18844/ijlt.v10i4.3634

[24] Pineida, F. O. (2020). Impact of aggressive online digital marketing on sales in the Latin American and Caribbean regions. Global Journal of Business, Economics and Management: Current Issues, 10(2), 91–99. https://doi.org/10.18844/gjbem.v10i2.4689

8 Authors

Jusuf Qarkaxhija, PHD, for five years in a row is in the position of Dean of the Faculty of Computer Science at AAB College and also a longtime teacher at the same Faculty. He is the author of over 30 scientific papers in highly indexed journals and participant in many activities inside and outside Kosovo. He has worked in many other institutions, both in higher education and in industry. It is his tenth year of work experience at AAB College.

Blerta Prevalla, PHD, is a full-time professor at the Faculty of Computer Science at AAB College, with many years of experience. She is also the author of over 20 scientific papers in prestigious international journals. She has worked in many institutions, both in university education and in industry holding different positions like Dean of the Faculty at AAB College, Vice Dean, IT Consultant for World Bank project etc.

Shpetim Latifi, PHD, is a professor at the Faculty of Computer Science at AAB College and also a Special Adviser for Education to the Minister of Education in North Macedonia. He has an extensive experience in the field of computer science especially in artificial intelligence, computer networks, etc.

Article submitted 2022-10-01. Resubmitted 2022-10-27. Final acceptance 2022-10-27. Final version published as submitted by the authors.

The Effectiveness of Mobile Learning Technology at the Tertiary Level During Conflicts

https://doi.org/10.3991/ijim.v16i23.33793

Liudmyla Holubnycha[1(✉)], Tetiana Besarab[1], Yana Pavlishcheva[1], Svitlana Romaniuk[1], Yuliia Sytnykova[2], Tetiana Ahibalova[3], Olena Alpatova[4]
[1] Yaroslav Mudryi National Law University, Kharkiv, Ukraine
[2] O. M. Beketov National University of Urban Economy, Kharkiv, Ukraine
[3] National Technical University «Kharkiv Polytechnic Institute», Kharkiv, Ukraine
[4] V. N. Karazin Kharkiv National University, Kharkiv, Ukraine
golubnichaya11@gmail.com

Abstract—The paper investigates the effectiveness of personal smartphones and other mobile devices for learning English at the tertiary level during not normal situation in Ukraine. The research methods included 1) general theoretical methods (analysis and synthesis); 2) empirical methods (quasi-experiment, observation, interpretation); 3) methods of mathematical statistics (Pearson's criterion). The material of the research involved 80 students of the first year of Yaroslav Mudryi National Law University (Kharkiv, Ukraine) during the spring semester of 2021/2022 academic year. There were two samples: the experimental group (N = 40) that learned the course of "Legal English" exclusively through mobile devices and the control group (N = 40) that had only traditional forms of learning. The results revealed that academic progress of the students of the experimental group have improved by 15%, while achievements of the students of the control group have deteriorated by 10%. The reliability of the results is confirmed by the methods of mathematical statistics (p-value = 0.25; the significance level was chosen as 0.05). The conclusion is that mobile learning technology, which is able to provide students with access to systematic online training; platforms containing different textbooks and other local and remote educational content; as well as various educational services may become a great teaching and learning tool.

Keywords—mobile learning, university students, military conflict, learning English

1 Introduction

Mobility is one of the main characteristics of modern society. Due to mobile technology people could continue communications, work, learning and solving a lot of everyday problems during Coronavirus restrictions. And now mobility is developing in all aspects of our life day by day. Educational sphere is not an exception. Today the potential of telecommunications, information and mobile technologies for educational purposes can hardly be overvalued. It is actively investigated by researchers [1]-[4]

and is becoming stable global pedagogical practice. Utilising mobile teaching and learning in addition to traditional forms and methods has already demonstrated increasing students' progress [5]. So, it is not surprising that new educational applications for mobile devices are constantly appearing [6]-[8].

Moreover, mobile teaching and learning have become an increasingly important part of the educational process in recent years. If educators mostly considered it as a complemented form of training before Coronavirus broke out, during quarantine measures mobile learning was often equal to distance learning through ordinary computers. That period enriched academic staff of Ukrainian Universities with the necessary experience as well as effective methodology and prepared them for teaching during the current conflict applying mobile learning technology, as in many cases mobile devices (mostly personal smartphones) appeared to be the only teaching and learning tools accessible for teachers and students from the zone of warfare.

Unfortunately, different hot spots appear in the world from time to time. What is more, some countries remain at conflicts for a long time and their citizens cannot and must not stop their living but have to continue its different spheres (including education both secondary and higher) in such circumstances so, it is relevant to study the role of mobile learning technology during military aggression when neither academic staff nor students have access to traditional forms and methods of teaching and learning or to ordinary computers. Studying the effectiveness of utilising mobile learning technology at the tertiary level during conflicts, which is proposed in the paper, may shed some light on the problem as well as be not only interesting from scientific point of view but also useful.

2 Literature review

2.1 Development of the phenomenon

As the study is focused on using mobile learning technology it seems appropriate to clarify the meaning of the concept "mobile learning technology", as well as to trace the emergence and development of this phenomenon. So, under mobile learning technology researchers understand the use of mobile technology in the learning process [9], [10]. It is widely used to provide distance education [11], [12] effectively complements traditional learning and training [13].

The start of mobile learning technology may be traced from the beginning of the millennium. Its concept is attributed to Keegan [14] who analysed a big amount of global experience of applying mobile devices for learning and teaching. Kukulska-Hulme and Traxler [15] created a handbook on mobile learning on the basis of the best investigated cases of mobile learning at the tertiary level. Kaliisa and Picard [16] reviewed the development of certain mobile learning methodology in Africa. Katsaris and Vidakis [17] surveyed 42 manuscripts focusing on individualised styles of e-learning to provide deliberated circumstances according to the needs and requirements of the students. The authors concluded that adaptive e-learning platforms for the stated purposes are not only efficient but also can improve the content of the les-

sons. Dahal et al. [18] touches upon the problems of developing teachers' skills in using ICT tools as well as qualitative engagement of students in distance learning. According to the researchers, autonomy and engagement of students are even more important than technology. Besides, the authors believe that distance teaching is not only one of the teaching forms but a "transition from paper to the digital world" of education.

In addition to numerous reviews there are several empirical studies. So, professional development of teachers in computer technology is also considered with application of empirical approach by Lazarinis et al. [19]. Analysing digital activism in students Aguayo et al. [20] found out that the students were less concentrated than in the traditional classroom and the teachers had to teach them to process the information. Some researchers studied motivation to use mobile learning and teaching technology [21]-[23] and revealed a certain increase in the students' interest in learning and a wish to develop innovative professional skills on the part of the teachers; others surveyed the attitude of teachers and students toward mobile learning [24]-[26] and found some distrust of the teachers as well as mostly positive attitude of the students. Considering teachers' opinions on distance education, Can and Bardakci [27] note a number of negative aspects, namely: lack of interaction between the subjects of the educational process, technological problems, and insufficient teaching content. Teachers' attitude to ICT in general in the context of the Greece programme "Further Education of Educators in the Use and Development of ICT (Information and Communication Technologies) in the educational process" was investigated by Kalogiannakis and Papadakis [28]. The findings can be described as some uncertainty of the teachers according to the use of ICT in their teaching experience but strong desire to develop their technological skills.

Theoretical papers on the problem have also been introduced into scientific circulation. For instance, necessary requirements for applying mobile devices in the educational process were determined by Thomas et al. [29]. Among manuscripts on mobile learning there are papers describing findings of academic staff from different countries [26], [30], [31], as well as results of asynchronous e-learning [32], [33].

However, all reviewed studies concern the use of mobile learning technology in peaceful settings, which differs to some extent from utilising this technology in military conflicts and which we tried to shield some light on.

2.2 Mobile learning technology in teaching English

As the research was conducted while teaching English as a foreign language and was aimed at testing the effectiveness of the mentioned technology, it is significant to focus on the papers related to the productivity of utilising mobile applications for learning foreign languages. So, Zhang [34] examined the advantages of applying different movies, short videos, animations, and others for teaching and learning English. Klimova [35] studied the impact of educational applications in smartphones on students' achievements in English vocabulary learning. Alwafi et al. [36] investigated developing English speaking skills through social virtual reality mobile application. All the researchers concluded that mobile learning technology is a useful complemen-

tary method of teaching and learning foreign languages as it contributes positively to the language learning, enhances students' performance and encourages them.

However, among the papers devoted to mobile learning technology in teaching English there have been no studies that would describe any aspects of application of mobile learning in zones of military action.

Thus, the *purpose* of the paper is to examine the efficiency of utilising mobile learning technology at the tertiary level during conflict.

The *hypothesis* of the authors is that mobile learning technology can be an effective learning tool compared to traditional training in the context of military actions, despite the difficult conditions for living and learning and full absence of access to classroom-based technologies as well as traditional forms of learning.

3 Methodology

3.1 Methods

In order to reach the stated purpose the following methods were used: 1) general theoretical methods such as: analysis and synthesis of researches describing mobile learning technology for understanding the essence of the notion and peculiarities of mobile learning and teaching, following necessary requirements, applying the best findings of pedagogical experience; 2) empirical methods such as: quasi-experiment, observation, interpretation; 3) methods of mathematical statistics (Pearson's criterion (χ^2)), built into MS Excel. We chose the non-parametric χ^2 Pearson's criterion consistency method to analyse the obtained data in two groups: experimental and control. This method allows us to assess the significance of the differences between the actual (observed in the experimental group) number of outcomes and the theoretical number that we have in the control group under a fair null hypothesis. As a null hypothesis, we accept the fact that there are no advantages during the conduct of various forms of education in the conditions of conflict in the country. In this way, we are trying to determine whether there are any advantages to the diversity of learning between categories (which we determine by evaluating the quality of the material learned), or the proportions differ from one category to another. Because we are testing a simple hypothesis and using asymptotically optimal clustering, the χ^2 Pearson consistency test has a robustness advantage over other nonparametric consistency tests.

The reliability and the validity of the experimental data are ensured by the equivalence of the selected groups in terms of number, age, and level of academic performance (we took the performance results of the students, who participated in our experiment, for the previous semester).

3.2 Participants

The research was conducted at the Yaroslav Mudryi National Law University (Kharkiv, Ukraine) during the spring semester of 2021/2022 academic year. The study involved 80 students of the first year who learned the course of "Legal English".

The experimental group (EG) consisted of 40 students who appeared inside the zone of military conflict (Kharkiv). They were living in bomb shelters with more or less stable electricity and Internet access and that is why those students could study only with the help of their personal smartphones but did it systematically. Moreover, mobile learning provided the academic staff with the ability to monitor real-time learning, and consequently, find and eliminate students' weaknesses and the students with high content saturation and immediate feedback from the teachers.

The control group (CG) had 40 students from occupied territories, which practically appeared in isolation. Those students did not have Internet access and had to study fully individually using only printed textbooks and exercise-books. Before the conflict they managed to get information about which material should be learned and which assignments and tests should be done during the semester and managed to pass photos of their results through the people who found the possibility to move to free Ukrainian territory and send those photos.

3.3 Instruments and research procedure

The research included three stages: preparatory, experimental and assessment.

At the *preparatory* stage the authors were sampling the members for the experimental and control groups. From 436 first year students of Yaroslav Mudryi National Law University (who were taught by the authors) the authors made up experimental and control groups according to the following principles: 1) students' results obtained at the final test of the previous term (by choosing the students with approximately similar results: equal number of members for experimental and control groups with satisfactory, good and excellent language proficiency, according to the final test results); 2) learning opportunities connected with places where the students appeared in the spring term when military aggression started (bomb shelters – for the experimental group, whose participants used mobile learning technology as the only learning tool; and occupation – for the control group, in which the students could only have printed textbooks and exercise-books and studied independently). So, we got two equal samples: the experimental group N = 40 and the control group N = 40. Each group included 12 students (30%) with satisfactory results after the first term, 16 students (40%) with good results and 12 students (30%) with excellent results. Thus, the authors suppose that the members of both samples had approximately similar language proficiency and level of motivation.

At the *experimental* stage during four months of the spring term the students of both groups were learning the same program material, completing similar assignments and at the end they had the same test. However, the students of the control group had to work fully individually using only printed textbooks and exercise-books without immediate feedback from the teachers. What is more, the authors are not sure that the students were working systematically and paid enough attention to the material. The students of the experimental group due to mobile learning technology had different educational opportunities: 1) access to systematic video Conferencing used not only as a learning tool improving the quality of learning, but also as a tool for working together, for closing the gap between learners and teachers, for reducing psychological stress caused by constant bombing; 2) access to the University's portal "Educa-

tional Electronic Information Complex" (EEIC) (https://neik.nlu.edu.ua/moodle/), which became a platform for off-line (asynchronous) education and contained e-textbooks, exercise-books, various methodical kits created by the academic staff of the department in order to help the students to develop different kinds of language activity; 3) access to cloud educational services (Quizlet, Kahoot!, Quizizz, Vocabulary etc.) where the teachers placed special lexical material for developing active vocabulary; 4) access to translation services, other local and remote content for completing assignments and preparing for lessons. But those students did not have any printed textbooks or exercise-books. Such a learning feature was unusual for the students and at first, they complained about the inconvenience associated with the lack of printed textbooks and exercise-books. Moreover, any traditional forms of education were inaccessible to them.

At the *assessment* stage the authors' hypothesis about effectiveness of mobile learning technology was checked. For this purpose, at the end of the term students of the experimental and control groups had to complete the same test. It is important that the test contained only the material learned during the term and verified the level of development of *reading and comprehension* skills and *use of English* skills. The results of the test in experimental and control groups were compared that allowed us to prove the productivity of mobile learning technology as the only teaching and learning tool in the zone of conflict. Although the participants of the experiment completed the same test the instruments for data gathering were different in the experimental and the control groups. As the teachers could not provide the students from occupied territories with a specially developed test for monitoring final results, the decision was made to use one of the final tests for self-control, included into the textbook which those students were applying for learning "Legal English" during the term. The teachers got photos of the test in the manner described above. For the experimental group that test was placed in Google Form.

4 Results

The results of the final test proposed to both experimental and control groups at the end of the term are demonstrated in comparison with the students' achievement before the beginning of the experiment (in number and per cent of students with satisfactory, good and excellent academic performance) in Table 1.

Table 1. Comparison of the students' results in the control and experimental groups at the beginning and at the end of the experiment

Results	**CG***				**EG****			
	Before		***After***		***Before***		***After***	
	N	%	N	%	N	%	N	%
Satisfactory	12	30	14	35	12	30	9	22.5
Good	16	40	14	35	16	40	17	42.5
Excellent	12	30	12	30	12	30	14	35

* Control group
** Experimental group

The analysis of data given in Table 1 reveals that in general the achievements of the experimental group have improved by 15%. So, the students with satisfactory language proficiency have managed to raise their level to good results (7.5%), the students with good academic performance have succeeded in levelling up (2.5%), consequently, the number of the students with excellent grades has increased (5%).

At the same time the results of the control group have deteriorated by 10%, namely: the number of students with satisfactory results has increased from 30% at the end of the first term to 35% at the end of the spring term; the number of students with good results has decreased from 40% to 35%. The number of students with excellent results remained stable. In our opinion, such decrease in the level of progress of students may be explained by absence of immediate feedback from the teachers and access to additional materials, translation services etc. Another reason may be not very high motivation among students with satisfactory and good language proficiency to work fully independently.

The comparative analysis of the students' performance in the two groups of our experiment participants is presented in the diagram (see Figure 1).

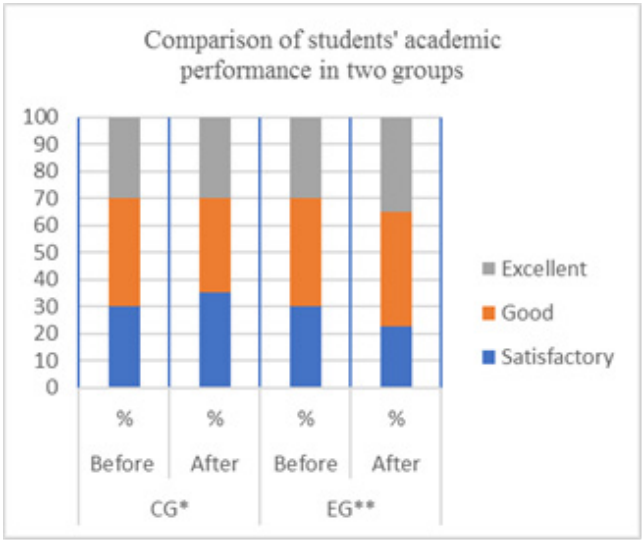


Fig. 1. Comparison diagram of students' academic performance

As we see in Figure 1, there were no significant changes in performance in the control group, while in the experimental group we observe a decrease in the number of students with satisfactory performance and an increase in the number of students with Excellent and Good results.

We carried out a statistical test of the hypotheses regarding the pedagogical experiment results using Pearson's criterion (χ^2-criterion) and estimated the probability of the obtained results. According to the proposed procedure, the null and alternative hypotheses were formulated to test the identified differences in students' achievement based on mobile learning and traditional learning. The test results of the students of

the two groups were ranked by performance levels into three categories "satisfactory, good, and excellent" and entered a free Excel spread sheet. The null hypothesis was defined as the absence of differences in the performance of students in both groups. An alternative hypothesis is that the deviations in performance categories are beyond random fluctuations, such discrepancies are statistically visible. To test this hypothesis, we used Microsoft Excel, namely a function χ^2 TEST. The significance level was chosen as 0.05. According to the obtained calculation results, the observed value was $\chi^2 = 2.76$, and the critical value for 2 degrees of a freedom was $\chi^2_{(0,05;2)} = 0.10$, so, we got that $\chi^2 > \chi^2_{(0,05;2)}$. Also, the p-value was 0.25. Thus, p-value is greater than 0.05 and this testifies in favour of the existence of differences between frequencies. Consequently, we reject the null hypothesis and accept the alternative hypothesis. It means that the authors' hypothesis was confirmed.

Thus, the mentioned signifies that mobile learning applied in the experimental group was more efficient according to the students' results during "Legal English" than traditional learning, which was utilised in the control group. The obtained results of our experiment do not contradict the research findings of Zhang [34], Klimova [35] and Alwafi et al. [36], who investigated mobile learning technology is a complementary method of teaching and learning English.

5 Discussion and limitation

Numerous aspects of mobile learning (benefits of the technology, requirements of its utilisation, motivation to use mobile learning, attitude of both teachers and students towards the mentioned form of learning, findings of academic staff, etc.) were proposed in recent papers.

The authors fully agree with the researchers who analysed the benefits of different Apps for learning English [34], [36], [37]. Moreover, we have verified the evidence of some apps efficacy for developing reading and comprehension skills and use of English skills. Being in alignment with the findings of Purnomo et al. [38] that due to mobile learning educational space is not limited to university auditorium but shifted into virtual form, the authors also have proved that study space may even appear in very unsuitable and unnatural conditions like bomb shelters. Completely sharing the opinions of the researchers [35], [36], [39] about the outcome of mobile learning technology for words, idioms boosting and other language skills developing, we have witnessed several supplementary possibilities provided by smartphones, which became no less important during the conflict. They are associated with closing the gap both inside academic groups and between academic staff and students when learners feel the need to be with their teachers and group mates, there is a psychological need to distract from the military action and that is mobile learning which helps in it. In addition, we strongly support the research results of Golonka et al [40] about the efficiency of using charts in teaching and learning foreign languages. What is more, the authors' experience has shown that during the conflict chats may sometimes become the only means of communication between learners and teachers enhancing students' productivity and interaction, motivating them and supporting psychologically as well

as providing feedback in the educational process. What is more, we can assume that online quizzes proposed as a primary learning tool by Mykytiuk et al. [1] result in the higher achievements of the students as we also used them in our mobile learning and teaching practice but unlike the stated authors, we considered them as an additional tool in the study of the English language. It is necessary to note also that we fully agree with Papadakis et al. [41] about the existence of a great number of mobile apps, which are created for learning, but their educational potential is different and not always sufficient. Although, the mentioned authors evaluated mobile apps for young children development, we came to the similar conclusion having done our investigation.

The limitations of the research are associated with the fact that the experiment was conducted based on the only University and the only academic subject. Moreover, the number of members of the experiment was limited to 80. But it was extremely difficult to select students for the control and experimental groups, on the one hand, because of changing situation on the front and capturing new territories, on the other hand, due to constant pressure of bombing, shelling, and missile attacks.

6 Conclusions

Thus, the study has examined the efficiency of utilising mobile learning technology at the tertiary level during conflict and has proved that mobile learning technology is effective not only as a complementary form of education but can be efficiently utilised at the tertiary level as the only training technique in zones of conflict. Moreover, mobile learning is a useful tool that provides psychological support to students in the context of military actions as well as motivates them to enhance their productivity and interaction. In addition, due to application of mobile learning technology teachers could monitor real-time learning that is especially important during military action. The experiment has shown that the students (the control group learning without application of personal mobile devices) who did not have feedback from the teachers and had to learn the subject completely independently could not improve their achievements. While academic performance of the students, who had the mentioned choice as well as different educational opportunities offered by mobile learning, has increased.

Accordingly, mobile learning technology that is able to provide students with access to systematic online training, platforms containing different textbooks and other local and remote educational content, as well as various educational services may become a great teaching and learning tool.

7 References

[1] Mykytiuk, S., Moroz, T., Mykytiuk, S., Moroz, M., & Dolgusheva, O. (2022). Seamless Learning Model with Enhanced Web-Quizzing in the Higher Education Setting - International Journal of Interactive Mobile Technologies (iJIM), 16 (03): 4–19. https://doi.org/10.3991/ijim.v16i03.27257

[2] Cabanillas-Carbonell, M., Cusi-Ruiz, P., Prudencio-Galvez, D., & Herrera Salazar, J. L. (2022) Mobile Application with Augmented Reality to Improve the Process of Learning Sign Language - International Journal of Interactive Mobile Technologies (iJIM), 16 (11): 51–64. https://doi.org/10.3991/ijim.v16i14.29785

[3] Papadakis, S. (2021). Advances in Mobile Learning Educational Research (AMLER): mobile learning as an educational reform - Advances in Mobile learning educational research, 1 (1): 1–4. https://doi.org/10.25082/AMLER.2021.01.001

[4] Holubnycha, L., & Baibekova, L. (2020). Modern technologies for university students' language learning in pandemic - Postmodern Openings, 2 (11): 59–65. https://doi.org/10.18662/po/11.2/158

[5] Liaw, S. S., Hatala, M., & Huang, H. M. (2010). Investigating acceptance toward mobile learning to assist individual knowledge management: based on activity theory approach - Comput. Educ., 54: 446–454. https://doi.org/10.1016/j.compedu.2009.08.029

[6] Bagaskara, S. A., Wibowo, A. T., Izzuddin, M. A., Milad, M. K., Setyowati, R. D. N., Taufik, T., Ridwan, M., & Arifin, S. (2022). Software Quality Testing In Mobile Application (ArabEasy) Based on the PACMAD Model - International Journal of Interactive Mobile Technologies (iJIM), 16 (10): 4–24. https://doi.org/10.3991/ijim.v16i10.28433

[7] Hussein, K. Q., & Al-Bayati, M. A. (2022). Multi-Mode e-Learning System of Reading Skills for Deaf Students Based on Visual Multimedia - International Journal of Interactive Mobile Technologies (iJIM), 16 (10): 67–78. https://doi.org/10.3991/ijim.v16i10.29831

[8] Karim, A. A., & Saleh, S. M. (2022). Face Image Animation with Adversarial Learning and Motion Transfer - International Journal of Interactive Mobile Technologies (iJIM), 16 (10): 109–121. https://doi.org/10.3991/ijim.v16i10.30047

[9] Quin, C. (2002). mLearning: Mobile, Wireless, In-Your-Pocket Learning, LiNE Zine, Fall 2002

[10] Wagner, E. D. (2005). Enabling Mobile Learning - EDUCAUSE Review, 40 (3): 40-53

[11] Zawacki-Richter, O., Brown, T., Delport, R. (2007). Mobile Learning = Distance Education 2.0? EDEN Annual Conference, 13 - 16 June 2007, Naples, Italy. pp. 49-57

[12] Sharples, M., Taylor, J., Vavoula, G. (2007). A Theory of Learning for the Mobile Age. In R. Andrews & C. Haythornthwaite (eds.) The Sage Handbook of E-learning Research. London: Sage, pp. 21-47. https://doi.org/10.4135/9781848607859.n10

[13] Keegan, D. (2005). The incorporation of mobile learning into mainstream education and training. World Conference on Mobile Learning, 2005, Cape Town, pp. 226-228

[14] Keegan, D. (2003). The future of learning: From e-learning to m-learning. http://learning.ericsson.net/mlearning2/project_one/book.html

[15] Kukulska-Hulme, A., & Traxler, J. (Eds.). (2005). Mobile learning – a handbook for educators and trainers, London: Routledge.

[16] Kaliisa, R., & Picard, M. (2017). A systematic review on mobile learning in higher education: the African perspective - Turk. Online J. Educ. Technol., 16: 1–18

[17] Katsaris, I., & Vidakis, N. (2021). Adaptive e-learning systems through learning styles: A review of the literature - Advances in Mobile Learning Educational Research, 1 (2): 124-145. https://doi.org/10.25082/AMLER.2021.02.007

[18] Dahal, N., Manandhar, N., Luitel, L., Luitel, B., Pant, B., & Shrestha, I. (2022) ICT tools for remote teaching and learning mathematics: A proposal for autonomy and engagements - Advances in Mobile Learning Educational Research, 2 (1): 289-296
[19] Lazarinis, F., Karatrantou, A., Panagiotakopoulos, C., Daloukas, V., & Panagiotakopoulos, T. (2022). Strengthening the coding skills of teachers in a low dropout Python MOOC - Advances in Mobile Learning Educational Research, 2 (1): 187-200. https://doi.org/10.25082/AMLER.2022.01.003
[20] Aguayo, J. M., Valdes, J., Cordoba, V. H., Nájera, M., Vázquez, F. R., Muñoz, E., & Lirios C. García (2022). Digital activism in students of a university in central Mexico in the COVID-19 era - Advances in Mobile Learning Educational Research, 2 (1): 297-307. https://doi.org/10.25082/AMLER.2022.01.014
[21] Ball, D., & Levy, Y. (2009). Emerging educational technology: assessing the factors that influence instructors' acceptance in information systems and other classrooms - J. Inform. Syst. Educ., 19: 431–443
[22] Chun, K. M. (2019). Pedagogical innovation through mobile learning implementation: an exploratory study on teachers' extended and emergent use of mobile learning systems (Doctoral dissertation). Northeastern University, Boston, MA, United States, 2019.
[23] Gan, C. L., & Balakrishnan, V. (2014). Determinants of mobile wireless technology for promoting interactivity in lecture sessions: an empirical analysis - J. Comput. Higher Educ., 26: 159–181. https://doi.org/10.1007/s12528-014-9082-1
[24] Çelik, H. C., & Karayaman, S. (2018). Investigating attitudes of prospective mathematics teachers towards the use of mobile learning at a higher learning institution - Univ. J. Educ. Res., 6: 1784–1794. https://doi.org/10.13189/ujer.2018.060823
[25] Chen, K. T. (2016). Examining EFL instructors' and students' perceptions and acceptance toward M-learning in higher education - Univ Access INF Soc., 16: 967. https://doi.org/10.1007/s10209-016-0494-8
[26] Baek, Y., Zhang, H., & Yun, S. (2017). Teachers' attitudes toward mobile learning in Korea - TOJET Turk. Online J. Educ. Technol., 16: 154–163
[27] Can, Y., & Bardakci, S. (2022). Teachers' opinions on (urgent) distance education activities during the pandemic period - Advances in Mobile Learning Educational Research, 2 (2): 351-374. https://doi.org/10.25082/AMLER.2022.02.005
[28] Kalogiannakis, M., & Papadakis, S. (2007). The dual form of further education of educators in ICT: technological and pedagogical training, Information and communication technology. In Proceedings of the 8th International Conference on Computer Based Learning in Science (CBLIS 2007), 30 June - 6 July 2007, Heraklion, Crete, Greece, pp. 265-276
[29] Thomas, K. M., O'Bannon, B. W., & Britt, V. G. (2014). Standing in the schoolhouse door: teacher perceptions of mobile phones in the classroom - J. Res. Technol. Educ., 46: 373–395. https://doi.org/10.1080/15391523.2014.925686
[30] Bere, A., & Rambe, P. (2019). Understanding mobile learning using a social embeddedness approach: a case of instant messaging - Int. J. Educ. Dev. Using Inf. Commun. Technol., 15: 132–153
[31] Brown, T. H. (2019). M-learning in Africa: Doing the unthinkable and reaching the unreachable. Open and Distance Learning Praxis in Africa - Pretoria: UNISA Press, 2019.
[32] Kikilias, P., Papachristos, D., Alafodimos, N., Kalogiannakis, M., & Papadakis, St. (2009). An Educational Model for Asynchronous E-learning: A Case Study in Higher Technology Education. In D. Guralnick (ed.), Proceedings of the International Conference on E-learning in the Workplace (ICELW-09), 10-12 June 2009, New York: Kaleidoscope Learning

[33] Alafodimos, K., Kalogiannakis, M., Papadakis, St., & Papachristos, D. (2009). Adult Education and Lifelong Learning. The Case of GSAE (General Secretary for Adult Education) in Greece. In D. Guralnick (ed.), Proceedings of the International Conference on E-learning in the Workplace (ICELW-09), 10-12 June 2009, New York: Kaleidoscope Learning

[34] Zhang, S. (2016). Mobile English learning: an empirical study on an APP, English fun dubbing - International Journal of Emerging Technologies in Learning, 11: 4–8. https://doi.org/10.3991/ijet.v11i12.6314

[35] Klimova, B. (2019). Impact of mobile learning on students' achievement results - Education Sciences, 9 (2): 90. https://doi.org/10.3390/educsci9020090

[36] Alwafi, G. A., Almalki, S., Alrougi, M. Meccawy, M., & Meccawy, Z. (2022). A Social Virtual Reality Mobile Application for Learning and Practicing English - International Journal of Interactive Mobile Technologies (iJIM), 16 (09): 55–75. https://doi.org/10.3991/ijim.v16i09.28289

[37] Eppard, J., Nasser, O., & Reddy, P. (2016). The Next Generation of Technology: Mobile Apps in the English Language Classroom - International Journal of Emerging Technologies in Learning (iJET), 11 (04): 21–27. https://doi.org/10.3991/ijet.v11i04.5293

[38] Purnomo, A., Kurniawan, B., & Adi, K. R. (2020). Expanding learning environment through mobile learning - International Journal of Emerging Technologies in Learning, 15 (7): 123–131. https://doi.org/10.3991/ijet.v15i07.13215

[39] Thornton P., & Houser, C. (2005). Using mobile phones in English education in Japan - Journal of Computer Assisted Learning, 21 (3): 217–228. https://doi.org/10.1111/j.1365-2729.2005.00129.x

[40] Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: a review of technology types and their effectiveness - Computer Assisted Language Learning, 27 (1): 70–105. https://doi.org/10.1080/09588221.2012.700315

[41] Papadakis, S., Vaiopoulou, J., Kalogiannakis, M., & Stamovlasis, D. (2020). Developing and Exploring an Evaluation Tool for Educational Apps (E.T.E.A.) Targeting Kindergarten Children - Sustainability, 12: 4201. https://doi.org/10.3390/su12104201

8 Authors

Liudmyla Holubnycha is Doctor of Sciences, Professor, Full Professor of the Department of Foreign Languages #3 of Yaroslav Mudryi National Law University, Pushkinska Str., 77, 61024 Kharkiv, Ukraine. The research interests are high school didactics, innovative methods of teaching English.

Tetiana Besarab is PhD, Associate Professor of the Department of Foreign Languages #3 of Yaroslav Mudryi National Law University, Pushkinska Str., 77, 61024 Kharkiv, Ukraine. The research interests are teaching English for specific purposes, innovative methods of teaching English.

Yana Pavlishcheva is PhD, Associate Professor of the Department of Foreign Languages #3 of Yaroslav Mudryi National Law University, Pushkinska Str., 77, 61024 Kharkiv, Ukraine. The research interests are teaching English for specific purposes, technology assisted learning.

Svitlana Romaniuk is PhD, Associate Professor of the Department of Foreign Languages #2 of Yaroslav Mudryi National Law University, Pushkinska Str., 77,

61024 Kharkiv, Ukraine. The research interests are teaching methodology, teaching English for specific purposes.

Yuliia Sytnykova is PhD, Associate Professor of the Department of Higher Mathematics and Mathematical Modelling of O. M. Beketov National University of Urban Economy, Marshal Bazhanov Str., 17, Kharkiv, 61002, Ukraine. The research interests are high school didactics, innovative methods of teaching Mathematics in English.

Tetiana Ahibalova is PhD, Associate Professor of the Department of Business Foreign Language and Translation, National Technical University «Kharkiv Polytechnic Institute», Kirpichova Str., 2, 61000 Kharkiv, Ukraine. The research interests are Linguistics, teaching English for specific purposes.

Olena Alpatova is PhD, Senior Lecturer of the Language Training Department, Institute of International Education for Study and Research of V. N. Karazin Kharkiv National University, Svobody Sq., 4, 61022 Kharkiv, Ukraine. The research interests are Linguistics, innovative methods of teaching English.

Article submitted 2022-07-04. Resubmitted 2022-09-09. Final acceptance 2022-09-09. Final version published as submitted by the authors.

Imprint

iJIM – International Journal of Interactive Mobile Technologies
http://www.i-jim.org

Indexing
International Journal of Interactive Mobile Technologies is indexed in **Elsevier Scopus, INSPEC, Ulrich, DOAJ, EBSCO, Google Scholar, and DBLP**.

Publication Frequency
Bimonthly

Publisher
International Association of Online Engineering (IAOE)
Kirchengasse 10/200
A-1070 WIEN
Austria