Mobile Technology in University Learning

Tecnología móvil en el aprendizaje universitario

Tecnologia móvel na aprendizagem universitária

Jorge Nelson Tejada Campos* Israel Barrutia Barreto**

* Degree in Mathematics Education, Teacher at the Universidad Nacional de Cajamarca.
** National Customs and Tax Administration Superintendent (SUNAT), Peru. E-mail: innovasciencia@gmail.com https://orcid.org/0000-0002-5728-0651

OPEN ACCESS

DOI: http://dx.doi.org/10.18634/sophiaj.17v.1i.1016

Article information

Received: October 08, 2020
Revised: January 12, 2021
Accepted: April 10, 2021
Published: April 15, 2021

Keywords: Learning, mobile learning, education, higher education, mobile technology.

Palabras clave: Aprendizaje, aprendizaje móvil, educación, educación superior tecnología móvil.

Palavras-chave: Aprendizagem móvel, tecnologia móvel, aprendizagem, ensino superior, educação.

How to cite:

Tejada, J.N., Barrutia, I. (2021) Mobile Technology in University Learning. *Sophia* 17(1), e1016

Sophia-Education, volume 17, number 1. January/June 2021. English version

Abstract

In the last decade, a significant number of initiatives have emerged that aim to use mobile technologies and applications for educational purposes. However, their implementation has not been fully effective due to various difficulties. This research explores the attitudes of students and teachers towards the use of mobile learning in higher education institutions. Samples were taken from students and teachers from five universities in Cajamarca, Peru, to which surveys were applied and validated by experts. Reliability was evaluated by Cronbach's alpha. It was assessed whether there are statistically significant differences between students' attitudes regarding age, sex, specialty, and type of mobile used. Likewise, it was evaluated whether there are statistically significant differences between teachers' attitudes regarding age, sex, university experience, academic level, and type of mobile used. A Student's *t*-test and a one-way analysis of variance (Anova) were performed for each indicator considered. The results revealed that there are statistically significant differences between students' attitudes regarding the type of mobile device. The emergence of mobile learning technologies had a significant impact on educational technology.

ISSN (electronic): 2346-0806 ISSN (printed): 1794-8932

Conflict of interest:

The authors declare that they have no conflict of interest.

Author Correspondence:

jonetecampos@gmail.com
israel20barrutia@gmail.com

RESUMO

Na última década, surgiu um número significativo de iniciativas que visam a utilização de tecnologias e aplicações móveis para fins educacionais, no entanto, a implementação não tem sido totalmente eficaz devido a várias dificuldades. Neste trabalho, foram exploradas as atitudes de alunos e professores em relação ao uso da aprendizagem móvel em instituições de ensino superior. Foram coletadas amostras de alunos e professores de cinco universidades de Cajamarca, no Peru, nas quais foram aplicadas pesquisas que foram validadas por especialistas e a reliabilitye foi avaliada pelo alfa de Cronbach. Foi avaliado se existem diferenças estatisticamente significativas entre as atitudes dos alunos em relação à idade, sexo, especialidade e tipo de móvel uso. Da mesma forma, avaliou-se se existem diferenças estatisticamente significativas entre as atitudes dos professores em relação à idade, sexo, experiência universitária, nível de escolaridade e tipo de celular usado. Os testes t de Student e uma análise de variância unilateral (ANOVA) foram realizados para cada indicador considerado. Os resultados revelaram que existem diferenças estatisticamente significativas entre as atitudes dos alunos em relação ao tipo de dispositivo móvel. O surgimento de tecnologias de aprendizagem móvel teve um impacto significativo na tecnologia educacional.

Introduction

Given the vertiginous advance of information and communication technologies, the incorporation of these tools in the educational environment has always been a focus of interest (Bernier, 2019). This revolution of the communications in the digital age brought with it a great paradigm shift in the education sector (Machado and Díaz, 2018). The implementation of various strategies from the digital sphere can raise the quality of education by helping to overcome certain limitations imposed by traditional teaching and learning strategies (Otero et al., 2019). This implementation is not only in the student environment but also in the teaching competencies that allow an effective achievement of the goals set (González, 2016).

In the case of learning mathematics, concern has always been reflected in the general performance of students. In this regard Medina, Fereira and Marzol (2018) reported that the personal factors of students have a moderate impact on the low performance of Geometry students, so they recommend implementing new strategies that contribute to student motivation in the direction of greater commitment to the subjects.

The availability of smartphones (*mobile phones*) at affordable prices has led to an increase in the use of applications (*Apps*) for various aspects of life, such as communication, travel, entertainment, productivity, and learning. In the last decade, there have been a significant number of initiatives that aim to use mobile technologies and applications for educational purposes (Kearney, Burden, and Rai, 2015; Bano et al., 2018; Romero, 2020).

In the literature, researchers have defined mobile learning from different perspectives. Mcconatha, Praul and Lynch (2008) have defined mobile learning as learning that is employed with small mobile computing devices. This definition includes smartphones and small handheld devices. In addition, Mirski and Abfalter (2004) defined mobile learning as a specific topic that is emerging from distance learning; while Ardies, De Maeyer, Gijbels and van Keulen (2015) argued that attitudes towards any educational technology could be used to know to what extent users (students and educators) have the ambition to use the technology and whether this has positive or negative impacts on the environment. Barki and Hartwick (1994) have empirically supported that user attitudes lead to the intentions of use and the actual user of the new system.

Several universities around the world have implemented this approach to deliver learning anytime, anywhere, in different ways. In Canada College and San Francisco State University (SFSU) the Interactive Learning Network (ILN) model was implemented, which involves both tablets and wireless technology for pre- and post-assessments to determine student performance (Enríquez, 2010). Erkollar and Oberer (2012) addressed the integration of mobile learning with the Geographic Information System (GIS) module in a pilot course within a Turkish university where each student received a tablet device equipped with *Google and Hangout Apps* to facilitate student communication. Glackin, Rodenhiser, and Herzog (2014) addressed the integration of mobile devices and e-books to increase students' familiarity with the digital library. De Pablos, Tennyson and Lytras (2015) conducted two studies at the American University of Sharjah, for undergraduate students to examine the use of iPads during a semester in the mathematics course.

Although mobile learning has been implemented by various institutions, it is pertinent, in the case of the Cajamarca region, to carry out a study of the attitudes of students and teachers regarding the implementation of mobile learning in the classroom. Therefore, the aim of this study was to explore the attitudes of students and teachers towards the use of mobile learning in higher education institutions to predict their intention to use mobile technology in the educational context. Therefore, this research seeks to answer the following research questions:

Is there a significant difference between students' attitudes towards using mobile learning regarding gender, specialization (major), type of mobile?

Is there a significant difference between teachers' attitudes towards using mobile learning regarding gender, academic level, experience, type of mobile?

ISSN (electronic): 2346-0806 ISSN (printed): 1794-8932

Methodology

For this work, an exploratory study was carried out to determine how higher education students and teachers perceive the usefulness of mobile devices in the educational context.

Population and sample

The study population consisted of five higher education institutions in the Cajamarca region, in Peru. The participating universities were the Universidad Nacional de Cajamarca (UNC), Universidad Nacional de Chota (UNACH), Universidad Privada Antonio Guillermo Urrelo (UPAGU), Universidad de San Pedro (USP) and Universidad Privada del Norte (UPN). The data was collected in the months of February and March 2019 through two surveys: one for students and one for teachers. Table 1 shows the details of the selected sample:

Table 1. Study participants

University	No. of Students	No. of teachers
Universidad Nacional de Cajamarca (UNC)	90	25
Universidad Nacional de Chota (UNACH)	90	25
Universidad Privada Antonio Guillermo Urrelo (UPAGU)	90	25
Universidad San Pedro (USP)	90	25
Universidad Privada del Norte (UPN)	90	25
Total	450	125

Source: Compilation by the authors.

The study used a purposive sampling approach where the samples drawn for the case of students were from the following majors: Education, Accounting, Law, and Environmental Engineering. Educators were also selected from different academic ranks and experiences (Onwuegbuzie and Collins, 2007; Teddlie and Yu, 2007). After obtaining the ethical approval of the universities, the researchers applied the face-to-face questionnaire delivered personally in class. It was reported to participants that their collaboration was entirely voluntary in the study and that their responses were confidential.

Instruments

The surveys applied to both teachers and students consisted of 28 items (questions). The first section was made up of eight items where the personal information, demographic data of students and teachers were recorded. The second section was made up of ten items that recorded students and teachers' information regarding the mobile technology used. The third section of the survey consisted of ten items that assessed attitudes towards the use of mobile learning. These surveys were designed following the five-point Likert scale to measure the ten items related to attitude: strongly agree (5), Agree (4), Undecided (3), Disagree (2) and strongly disagree (1). Attitudes have been calculated by combining the ten items in the third section of each survey.

The two surveys have been developed by the authors; however, some elements have been adopted from relevant studies to ensure validity of content (Liaw and Huang, 2012; Cavus, 2011; Alwraikat and Al Tokhaim, 2014) and guarantee their validity (Chang and Tung, 2008). Both referred to mobile learning, the first to the attitudes of students and the second, to the attitudes of teachers. The surveys were submitted to the judgment of three experts from the Universidad de Cajamarca to verify the clarity of the questions. All questions were randomized to avoid bias because the grouping of questions can influence one over the other (Ardies et al., 2015).

Data analysis

A previous general analysis was carried out using descriptive statistics together with an exploratory factorial study for the questions related to attitude in both surveys using the extraction method of principal component analysis with Varimax rotation. Students' attitudes (P1-10 in Table 2) were loaded in a single factor (between 0.787 and 0.891) and teachers' attitudes (P1-10 in Table 3) were loaded in a single factor (between 0.691 and 0.881).

A reliability test was performed for the ten independent variables representing attitudes by calculating Cronbach's alpha (Khaddage and Knezek, 2013; Zhang,). These Cronbach's alpha values for student attitudes were 0.912 and 0.925 for teachers, both greater than 0.7.

To assess whether there are significant differences between student attitudes and the other variables, Student's t-tests and one-way analysis of variance (Anova) were performed. All statistical analyses were performed using the SPSS program® version 25.

Results

When analyzing the personal and demographic data of the students, the results indicated that 58.2% of the students are female and 40.8% are male. In terms of ages, 89.1% of students are between the ages of 18 and 22. 53.7% of the students came from the Education major, while 28%, 11.4% and 6.4% came from Accounting, Law and Environmental Engineering, respectively.

On the other hand, when analyzing the personal and demographic data of teachers, the results revealed that 70.1% of educators were men, while the rest were women. 49.1% of teachers hold a master's degree, while those with doctorates and bachelor's degrees were 33.6% and 17.1%, respectively. 59% of the participants were in the instructor range.

When analyzing the information regarding the students' mobile devices, the results showed that 70.8% of them only own a *Smartphone*, in addition, 28.8% own a tablet, while the rest of the students do not own a Smartphone or Tablet. Of these students, 44.6% are using their mobile devices (*smartphone or tablet*) to surf the web, access their emails and use *Apps* for specific functions, while 15.8% of these were using their devices as tools to study through searches for information on the web, messaging, as well as the download of specific *Apps* that serve as complementary tools in their learning. "*WhatsApp*" is the most popular messaging app as it is used by 86.7% of students.

When analyzing the attitudes of students towards mobile technology, it has been observed that the total average score of attitudes was 3.21 and the average score of their perception of usefulness when using mobile devices in their studies was 3.18, the perception of these regarding the role in supporting communication with their peers and teachers has achieved the highest average score of 3.587. Also, the average score of the perception of self-improvement and the development of their learning processes and skills was 3.35.

When analyzing mobile technology information in teachers, the results have indicated that 59.3% of teachers own a Smartphone, 41.2% own a Smartphone and a tablet, and 2.4% of them have none. 58.9% of teachers use their mobile devices to surf the web, access their emails and use *Apps.* Of this group, only 18.4% use their mobile devices for learning/education. They use *Apps* to improve their strategies. 79.8% of teachers indicated that they were not using their mobile devices in teaching. *WhatsApp* takes the highest percentage with 80.5%

ISSN (electronic): 2346-0806 ISSN (printed): 1794-8932

compared to Telegram (14.1%) and SMS (2.1%). 65% of teachers indicated that the daily use of their mobile devices for educational purposes is less than two hours.

When analyzing teachers' attitudes toward mobile technology, we found that the average total score of educators' attitudes was 3.53 and the average score of their perception of usefulness of mobile device use in the educational process was 3.78. The average score of the role of mobile technology in supporting communication with other colleagues and students was 3.74, while the average score of the perception of facilitating access, retrieval and exchange of information and materials was 4.12. The average perception score using mobile learning for students was 3.32, and the average score of the perception of self-improvement and the development of their working processes and skills was 3.57.

Below are the results that answer the research questions posed.

Q: Is there a significant difference between students' attitudes towards using mobile learning regarding gender?

An independent *t* test was conducted to examine whether there is any significant difference between students' attitudes towards mobile learning use with respect to their gender. According to Table 2, the mean values for male and female students do not indicate significant differences between students in terms of their attitudes in terms of their gender. The calculated value of t was 1.289 and the significance level $p = 0.378$, ($p > 0.05$). The result of this question could be attributed to the fact that male students in the region are working with female students in almost all activities and both have sufficient handling of mobile technology. Therefore, no statistically significant difference has been noted.

Q: Is there a significant difference between teachers' attitudes towards using mobile learning regarding gender?

To examine whether there is any statistically significant difference between teachers' attitudes towards the use of mobile learning with respect to their gender, a *Student's-t* analysis was conducted. Table 2 shows the results where it is indicated that the average scores for men and women do not imply significant differences ($p = 0.412$, $p > 0.05$) between teachers in their attitudes regarding their gender.

Table 2. Differences between students' and teachers' attitudes regarding their gender

	Gen	N	Mean	Standard Deviation	t	df	Sig.
Students							
Attitudes	Male	155	3.5124	1.09775	1.289	450	0.378
	Female	295	3.3841	0.96519			
Teachers							
Attitudes	Male	86	3.4583	0.95471	-0.721	120	0.412
	Female	39	3.6278	0.73643			

Source: Compilation by the authors.

Q: Is there a significant difference between students' attitudes towards using mobile learning with regard to specialization (major)?

A one-way analysis of variance (Anova) was performed to test whether there is any statistically significant difference between the mean values. As shown in Table 3, the results revealed that there are no statistically significant differences ($p = 0.914$, $p > 0.05$) between students' attitudes regarding their academic specialties. The result of this research question could refer to the reason why almost all students were using their mobile devices (smartphones/tablets) to access their emails, chat on social media, share files through cloud services. Therefore, no significant differences have been reported.

Q: Is there a significant difference between students' attitudes towards using mobile learning with respect to the type of mobile device used?

A one-way analysis of variance (Anova) was performed to test whether there is any statistically significant difference between the mean values. The results revealed that there are statistically significant differences ($p = 0.047$, $p \leq 0.05$) between students' attitudes regarding the type of mobile device.

To determine where differences in mean values occur, the Tukey test was used for *post-hoc* comparisons. The results indicated that there are statistical differences between the attitudes of students with smartphones and those with smartphones and tablets, where differences are in favor of both devices.

Table 3. ANOVA results for students' attitudes toward their major

	Sum of square	df	Error quad or middle	F	Sig.
Regarding their major					
Intra Groups	0.479	3	0.162	0.156	0.914
Within Groups	393.244	425	1.035		
Total	393.723	428			
Regarding the type of mobile used					
Intra Groups	9.124	3	3.125	3.154	0.047
Within	395.654	425	1.204		
Total	404.778	428			

Source: Compilation by the

Q: Is there a significant difference between teachers' attitudes towards using mobile learning regarding their academic level?

A one-way analysis of variance (Anova) was performed to test whether there is any statistically significant difference between the mean values. The results revealed that there are no statistically significant differences ($p = 0.398$, $p > 0.05$) between teachers' attitudes regarding their academic level.

ISSN (electronic): 2346-0806 ISSN (printed): 1794-8932

Table 4. Mean and standard deviation for teachers' attitudes towards their level and experience

Academic level	N	Mean	Standard Deviation
Instructor	53	3.4301	0.66275
Assistant Teacher	31	3.4111	1.15358
Associate Teacher	23	4.1212	0.49748
Full-time Teacher	18	3.6700	0.12764
Total	125	3.5148	0.71401
Experience Academic	**N**	**Mean**	**Standard Deviation**
Less than 5 years	38	3.4121	0.75347
5 to 10 years	12	3.8000	0.82877
More than 10 years	75	3.5175	0.84021
Total	125	3.7361	0.86623

Source: Compilation by the authors.

Q: Is there a significant difference between teachers' attitudes towards using mobile learning regarding their academic experience?

Tables 5 and 6 show the values of the means and standard deviation for Anova. The results revealed that there are no statistically significant differences ($p = 0.398$, $p > 0.05$) between teachers' attitudes regarding their academic level.

Table 5. Anova results for teachers' attitudes towards their level and academic experience

With respect to the academic level					
	Sum of		Quadratic Mean		
Intra Groups	2.115	3	0.668	0.950	0.398
Within	34.181	117	0.682		
Total	36.296	120			

Regarding their academic experience					
	Sum of squares	d f	Mean square error	F	Sig.
Intra	0.269	2	0.079	0.112	0.798
within	36.037	118	0.704		
Total	36.306	120			

Source: Compilation by the authors.

Q: Is there a significant difference between teachers' attitudes towards using mobile learning with respect to the type of mobile device used?

The mean values and standard deviations for the type of mobile device used by teachers are shown in Table 6. To examine whether there is any statistically significant difference between the mean scores, a one-way analysis of variance (ANOVA) was performed as shown in the table mentioned. The results revealed that there are statistically significant differences ($p = 0.047$, $p \leq 0.05$) between teachers' attitudes regarding the type of mobile device.

Table 6. Teachers' attitudes towards the type of mobile device

Mean and standard deviation			
Type of mobile	N	Mean	Standard Deviation
Smartphone	70	35.812	0.74975
Tablet	7	34.125	-
Both	42	39.061	0.93385
None	6	36.102	0.56569
Total	125	37.370	0.82512

ANOVA Results					
	Sum of Sq	df	Quadratic error	F	Sig.
Intra Groups	2.450	3	0.888	1.262	0.447
Within Groups	33.864	117	0.786		
Total	35.534	120			

Source: Compilation by the authors.

Discussion

Results on students' attitudes toward their gender do not report any statistically significant difference. These results coincide with the studies of Cavus (2011), Wang, Wu and Wang (2009), Uzunboylu, Cavus and Ercag (2009) and Yang (2012) who also found that there were no significant differences between students' attitudes towards using mobile learning with respect to their gender. However, Taleb and Sohrabi (2012), Khaddage and Knezek (2013) in their research have indicated that there are significant differences between students' attitudes towards gender, where female students were more positive towards mobile phone use than male students.

ISSN (electronic): 2346-0806 ISSN (printed): 1794-8932

On the other hand, with respect to the attitudes of students regarding their academic specialties, no significant differences have been reported either, these results contrast those reported by Khaddage and Knezek (2013) who indicated that students who own smartphones were more positive towards mobile learning than those who do not own ($p < 0.03$). Also, they corroborate those of the study of Taleb and Sohrabi (2012), which revealed that there were no significant differences between the attitudes of students towards the use of mobile learning in terms of their academic specialties.

Regarding teachers' attitudes towards the use of mobile learning with respect to their gender, the results indicate that the mean scores for men and women do not imply significant differences ($p = 0.412$, $p > 0.05$) between teachers in their attitudes towards their gender. These results are contradictory to those of Alwraikat and Al Tokhaim (2014), who revealed using an independent t test that the attitudes of the female instructors were more positive towards the mobile than the male instructors. In addition, Uzunboylu and Ozdamli (2011) indicated that the attitudes of male instructors were more positive towards mobile learning than female instructors.

On the other hand, the results revealed that there are no statistically significant differences ($p = 0.398$, $p > 0.05$) between the attitudes of teachers regarding their academic level. These results differ from Alwraikat and Al Tokhaim's (2014) who indicated through the use of an ANOVA test that the attitudes of the instructors, that is, young teaching assistants were more positive towards mobile learning than academic staff with higher ranks. They also highlighted that the attitudes of teachers with 21 years of experience or more were more positive towards mobile learning than others.

Conclusions

The emergence of mobile learning technologies had a significant impact on educational technology. This paper has highlighted the state of the art in mobile learning with respect to the attitudes of students and teachers towards the use of mobile learning in higher education institutions. The main contribution of this study was to explore the attitudes of students and educators, which in turn can serve as a basis for installing a mobile learning infrastructure.

Decision-makers at those academic institutions could take those significant differences into account in the implementation of mobile learning systems in the future. The use of tablets and smartphones will improve students' positive attitudes towards learning, which in turn leads to the intention to use mobile learning in higher education. Differences in age could spur authorities to design a special mobile learning system that can be adapted to all ages.

References

Alwraikat, M., & Al Tokhaim, H (2014). Exploring the potential of mobile learning use among faculty members. *International Journal of Interactive Mobile Technologies (IJIM)*. 8(3), 4-10 http://dx.doi.org/10.3991/ijim.v8i3.3682

Ardies, J., De Maeyer, S., Gijbels, D., and van K, H (2015). Students' attitudes towards technology. *International Journal of Technology and Design Education*. 25, 43-65. https://doi.org/10.1007/s10798-014-9268-x

Bano, M., Zowghi, D., Kearney, M., Schuck, S., Aubuson, P (2018). Mobile learning for science and mathematics school education: A systematic review of empirical evidence. *Computers & Education*. 121.30-58. https://doi.org/10.1007/s10798-014-9268-x

Barki, H., & Hartwick, J (1994). Measuring user participation, user involvement, and user attitude. *MIS Quarterly*. 18(1), 59-82, https://doi.org/ 10.2307/249610

Bernier, J (2019). Efectividad educativa del Facebook para el desarrollo de la comprensión lectora. Revista *TE- LOS*. 21 (2), 313-332. http://ojs.urbe.edu/index.php/telos/article/view/3113

Cavus, N. (2011). Investigating mobile devices and LMS integration in higher education: student perspectives. *Computer Science Proceeding*. 3.1469-1474. https://doi.org/10.1016/j.procs.2011.01.033

Chang, Su CH., and Tung, Feng-Chen. (2008). An empirical investigation of students' behavioural intentions to use

the online learning course websites. *British Journal of Educational Technology*, 39 (1),71-83. https:// doi.org/10.1111/j.1467-8535.2007.00742.x

De Pablos, P., Tennyson, R., and Lytras, M (2015). *Assessing the role of Mobile technologies and distance learning in higher education*. United Kingdom: Editorial IGI Global.

Enriquez, A (2010). Enhancing student performance using tablet computers. *College Teaching*. 58(3), 77-84. https://doi.org/10.1080/87567550903263859

Erkollar, A., & Oberer, B (2012). Anytime. Everywhere. Mobile learning in higher education: creating a GIS course. Germany: *Computer applications for database, education, and ubiquitous computing* Heidelberg

Glackin, B, Rodenhiser, R., & Herzog, B (2014). A library and the disciplines: a collaborative project assessing the impact of ebooks and mobile devices on student learning. *The Journal of Academic Librarianship*. 40(3- 4), 299-306. https://doi.org/10.1016/j.acalib.2014.04.007

González, M (2016). Formación docente en competencias TIC para la mediación de aprendizajes en el Proyecto Canaima Educativo. Revista *TELOS.* 18 (3), 492-507. http://ojs.urbe.edu/index.php/telos/article/ view/741

Kearney, M., Burden, K., & Rai, T. (2015). Investigating teachers' adoption of signature mobile pedagogies. *Computers & Education.* 80, 48-57. https://doi.org/10.1016/j.compedu.2014.08.009

Khaddage, F., & Knezek, G (2013). iLearn via mobile technology: a comparison of mobile learning attitudes among university students in two nations. *In Advanced learning technologies (ICALT)*, 2013 IEEE 13th international conference on pp. 256e258. IEEE.

Liaw, Shu-Sheng., and Huang Hsiu-Mei (2012) A Case of Study of Investigating Users' Acceptance toward Mobile Learning. In: Gaol F. (eds) Recent Progress in Data Engineering and Internet Technology. Lecture Notes in Electrical Engineering, vol 157. Springer, Berlin. Heidelberg

Machado, J., & Díaz, G (2018). Recursos da web 2.0 no mestrado em ciências da educação no instituto superior de ciências de educação do Huambo. Revista *TELOS*. 20(1), 82-100 http://ojs.urbe.edu/index.php/te- los/article/view/911

Medina, N., Fereira, J., & Marzol, R (2018) Factores personales que inciden en el bajo rendimiento académico de los estudiantes de geometría. Revista *TELOS*. 20 (1), 4-28. http://ojs.urbe.edu/index.php/telos/article/ view/899

Mcconatha, D., Praul, M., & Lynch, M (2008). Mobile learning in higher education: an empirical assessment of a new educational tool. *The Turkish Online Journal of Educational Technology - TOJET*. 7 (3), 15-21. Retrieved from: https://files.eric.ed.gov/fulltext/EJ1102943.pdf

Mirski, P., & Abfalter, D. (2004). Knowledge enhancement on site-guests' attitudes towards m-learning. In *Proceeding of the information and communication technologies in tourism 2004*, Cairo: Egypt.

Otero, A., Rivera, W., Pedraza, C., & Canay, J. R (2019). TIC para la educación: Sistema adaptativo basado en mecanismos de aprendizaje automático para la apropiación de tecnologías en estudiantes de educación media. Revista *TELOS*. 21 (3),526-543. www.doi.org/10.36390/telos213.03

Onwuegbuzie, A., & Collins, K (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report.* 12 (2), 281-316. https://nsuworks.nova.edu/tqr/vol12/iss2/9

Romero, R. (2020). Depression and the meaning of life in university students in times of pandemic. *Internation- al Journal of Educational Psychology,* 9(3), 223-242. https://doi.org/10.17583/ijep.2020.6784

Taleb, Z., & Sohrabi, A (2012). Learning on the move: the use of mobile technology to support learning for university students. *Procedural-Social and Behavioral Sciences*. 69, 1102-1109 https://doi.org/10.1016/j.sbspro.2012.12.038 .

Teddlie, Ch., & Yu, F (2007). Mixed methods sampling a typology with examples. *Journal of Mixed Methods Research*. 1(1), 77-100. https://doi.org/10.1177/1558689806292430

ISSN (electronic): 2346-0806 ISSN (printed): 1794-8932

Uzunboylu, H., Cavus, N., & Ercag, E. (2009). Using mobile learning to increase environmental awareness. *Computers & Education.* 80, 48-57. https://doi.org/10.1016/j.compedu.2014.08.009

Uzunboylu, H., & Ozdamli, F (2011). Teacher perception for m-learning: scale development and teachers' perceptions. *Journal of Computer Assisted Learning*. 27(6), 544-556. https://doi.org/10.1111/j.1365- 2729.2011.00415.x

Wang, Yin-Shun., Wu, Ming-Cheng., & Wang, Hsiu-Yuan (2009). Investigating the determinants and age and gen- der differences in the acceptance of mobile learning. *British Journal of Educational Technology*. 40 (1), 92-118. https://doi.org/10.1111/j.1467-8535.2007.00809.x

Yang, Shih-hsien (2012). Exploring college students' attitudes and self-efficacy of mobile learning. *The Turkish Online Journal of Educational Technology - TOJET*. 11(4), 148-154. Retrieved from: http://files.eric.ed.gov/full-text/EJ989264.pdf

Zhang, Xi., De Pablos, P., & Xu, Q (2014). Culture effects on the knowledge sharing in multi-national virtual classes: a mixed method. *Computers in Human Behavior*. 31. 491-498. https://doi.org/10.1016/j. chb.2013.04.021