Praxis / Vol. 21, No. 2 – 2025 / xx - xx
DOI: http://dx.doi.org/10.21676/23897856.6184

Artículo de investigación científica y tecnológica

The potential of augmented reality and gamification in higher education. A case study on usability

El potencial de la realidad aumentada y la ludificación en la educación superior. Un estudio de funcionalidad

César Augusto Mejía Gracia [1], Rodrigo Aryan Hernández García [2], Maridalia Ladrón de Guevara Smith [3]

Para citar este artículo: Mejía-Gracia C, Hernández-García, R, Ladrón de Guevara-Smith, M. The potential of augmented reality and gamification in higher education. A case study on usability. Praxis. 2025;21(2): xx-xx. http://dx.doi.org/10.21676/23897856.6184

Recibido en septiembre 09 de 2024
Aceptado en diciembre 29 de 2024
Publicado en línea en mayo 02 de 2025

ABSTRACT

Education is constantly evolving, and the use of information technologies offers opportunities to implement new methodologies and tools that improve the effectiveness of the educational process. This study evaluates the usability of an educational application that uniquely combines augmented reality (AR) and gamification in the context of university education, specifically within the Digital Marketing field. The research approach was descriptive and mixed, using the System Usability Scale (SUS) to measure the application's usability. Surveys and statistical analyses were conducted to collect and interpret data on user perceptions of the tool's effectiveness and ease of use. Key findings reveal that the combination of AR and gamification significantly enhances the educational experience for university students. The application received high scores for usability on the SUS scale, indicating that students found the tool intuitive and effective for reinforcing their knowledge. Notably, strong correlations were observed between ease of use, speed of learning, and knowledge reinforcement. Despite the positive reception, users pointed out areas where the application could be simplified to improve the overall user experience. The study underscores the importance of usability and user satisfaction in adopting AR in educational settings.

Keywords: augmented reality; gamification; education; usability; technology.

RESUMEN

La educación está en constante evolución y el uso de las tecnologías de la información ofrece oportunidades para implementar nuevas metodologías y herramientas que mejoren la eficacia del proceso educativo. Este estudio evalúa la usabilidad de una aplicación educativa que combina la realidad aumentada (RA) y la gamificación en el contexto de la educación universitaria, específicamente en el campo del Marketing Digital. El enfoque de la investigación fue descriptivo y mixto, utilizando la escala de usabilidad del sistema (SUS) para medir la usabilidad de la aplicación. Se realizaron encuestas y análisis estadísticos para recopilar e interpretar datos sobre las percepciones de los usuarios sobre la eficacia y la facilidad de uso de la herramienta. Los hallazgos clave revelan que la combinación de RA y gamificación mejora significativamente la experiencia educativa de los estudiantes universitarios. La aplicación recibió altas puntuaciones de usabilidad en la escala SUS, lo que indica que los estudiantes encontraron la herramienta intuitiva y eficaz para reforzar sus conocimientos. Cabe destacar que se observaron fuertes correlaciones entre la facilidad de uso, la velocidad de aprendizaje y el refuerzo de conocimientos. A pesar de la recepción positiva, los usuarios señalaron áreas en las que la aplicación podría simplificarse para mejorar. El estudio subraya la importancia de la usabilidad y la satisfacción del usuario a la hora de adoptar RA en entornos educativos.

Palabras clave: realidad aumentada; gamificación; educación; usabilidad; tecnología.

1. PhD. Universidad Veracruzana, Xalapa, México. Correo: cemejia@uv.mx - https://orcid.org/0000-0001-8874-0473
2. PhD. Universidad Veracruzana, Xalapa, México. Correo: rodrhernandez@uv.mx - https://orcid.org/0000-0002-2299-5366
3. PhD. Universidad Veracruzana, Xalapa, México. Correo: mladrondeguevara@uv.mx - https://orcid.org/0009-0001-9276-4715

INTRODUCTION

With the increasing use of technology in education, there is a growing interest in exploring the effectiveness of emerging technologies like augmented reality (AR) and gamification in enhancing the learning experience, in addition, understanding and improving the usability of educational tools is crucial for ensuring their effective integration into educational practices and maximizing their educational potential.

This study incorporates an innovative educational approach with significant potential to improve student engagement, motivation, and knowledge retention. It aligns with current trends in educational technology that explore the effectiveness of emerging technologies. Furthermore, it addresses a notable research gap regarding the specific combination of AR and gamification in education, thereby contributing novel insights to the academic field.

This article focuses on the evaluation of the usability of an educational application as its main objective; This evaluation aims to understand how students perceive the tool in terms of ease of use, effectiveness in reinforcing knowledge, and overall user experience. In addition, it seeks to investigate the impact of the integration of AR and gamification in university students' subjects.

Main contribution

Examine the usability and effectiveness of an educational application that integrates augmented reality (AR) and gamification. It aims to provide valuable insights into the application's impact on student learning in the field of Digital Marketing and to contribute to the ongoing discourse on the integration of advanced technologies in educational practices.

State of the art

Technological evolution in the digital age has revolutionized the way education is conceived, going beyond just the transmission of knowledge to advocate for deep participation and commitment on the part of students. In this context, the strategic fusion of two tools, gamification and augmented reality, is an avant-garde pedagogical tactic based on information technologies that enhances the teaching and evaluation of complex university topics such as digital marketing.

Gamification in education

Gamification has established itself as an effective tool to improve student participation and learning. By applying game elements in educational contexts, it is possible to increase intrinsic motivation, promote problem-solving, and create more immersive learning experiences.

The constructivist theory maintains that the learning process materializes only when the student pleasantly interprets new experiences. In this sense, play has been recognized as an essential component for people to achieve meaningful knowledge acquisition. This potential can be incorporated into education through the principles linked to gamification, which implies the integration of elements of games in contexts not related to entertainment (Deterding et. al, 2011, cited by Guzmán-Rivera et. to 2020).

Therefore, the educational strategy of gamification has gained prominence since its inception in 2010 (Llorens et al., 2016, cited by Guzmán-Rivera et al., 2020). From this perspective, it is presented as an effective tool to facilitate learning. Both gamification and constructivist theory emphasize the importance of student experience, making the synergy between traditional pedagogical theories and technological

innovations evident.

Constructivist theory suggests that learning is most effective when it is built on meaningful and contextualized experiences. Analogously, gamification uses game elements to create educational environments that engage and connect the student with concepts in a more palpable way. By recognizing play as an essential component for the acquisition of meaningful knowledge, the synergy between traditional pedagogical theories and technological innovations is validated.

Although the constructivist approach is one of the most widespread models today, there are emerging approaches, such as the theory of connectivism, proposed by Siemens and Downes (Sobrino-Morrás, Á., 2014). This theory emphasizes learning in the digital age and argues that knowledge is distributed through networks of connections, something that gamification naturally facilitates by creating interactive and collaborative environments. Connectivism recognizes that learning can reside on non-human devices, a perspective that aligns perfectly with gamification principles and its use of digital platforms.

Likewise, ubiquitous learning or "u-learning", a contemporary theory that refers to an evolution of electronic learning adapted to the progress of information and communication technologies (Berrones-Yaulema et al., 2023), reinforces the relevance of gamification in current educational processes. This theory, which postulates that learning can occur at any time and place, finds a natural ally in gamification since gamified strategies can quickly adapt to different contexts and learning moments (Olivo et al., 2023). The ubiquity of learning, combined with game elements, allows for the creation of continuous and coherent educational experiences that transcend the traditional boundaries of the classroom.

Kolb and Kolb (2017) proposed a digital experiential learning theory that suggests that technology-mediated experiences can be as meaningful as in-person ones when properly designed. This theory aligns with gamification principles, as both emphasize the importance of interaction, immediate feedback, and the active construction of knowledge through meaningful digital experiences.

Flow theory is "an optimal psychological state, or a sensation that people perceive when they are involved in an activity characterized by intense involvement where consciousness and action merge" (Riccetti et al., 2021, p. 293). This educational theory focuses on the idea that learning is most effective when students are fully immersed and focused on the task at hand, which is known as the "flow" state. ". Gamification, with its tiered challenges and rewards, can foster this state by keeping students engaged and motivated, which promotes deep learning.

On the other hand, the Discovery Learning theory maintains that students learn better when discovering information independently rather than passively receiving it from a teacher. Gamification is a perfect tool for discovery learning, as it allows students to explore and find solutions to problems in an interactive and controlled environment, encouraging curiosity and active learning. (Aldalur, I., & Perez, A., 2023).

Additionally, the STEAM (Science, Technology, Engineering, Art, and Mathematics) educational approach finds gamification the ideal implementation method. This interdisciplinary perspective, which seeks to integrate these areas of knowledge holistically, benefits enormously from gamification strategies since the playful elements allow the creation of scenarios where students can experiment with concepts from multiple disciplines simultaneously and meaningfully (Boytchev, P. and Boytcheva, S., 2020). Gamification in the STEAM context facilitates complex problem-solving, encourages critical thinking, and promotes creativity, allowing students to visualize and understand the connections between different fields of knowledge while staying motivated and engaged in their learning.

Furthermore, the hybrid learning model, or blended learning, is a comprehensive educational strategy that responds to the need for adaptability and flexibility in higher education. This approach effectively combines in-person and digital interactions, taking advantage of the strengths of both contexts to enrich the educational experience. According to Graham (2006, cited by Salinas et al., 2018), this model is characterized by the convergence of traditional and distributed learning environments, thus benefiting from technological evolution that facilitates distance communication and interaction.

Implementing gamification tools emerges as a valuable resource to further enhance the effectiveness of the blended learning model. Gamification, which involves using game design elements and principles in non-game contexts, can foster greater participation and motivation among students. By integrating game mechanics such as points, badges, and leaderboards into the educational environment, students may feel more encouraged to actively participate and take a more central role in their autonomous learning process.

This fusion improves interaction and participation in both learning modalities and promotes the development of key skills such as problem-solving, critical thinking, and collaboration.

Cuba and Pérez (2021) in their study Application of gamification in the design of activities in Distance Education, suggest that the incorporation of recreational elements, or gamification, in the educational context, promotes a series of significant advantages in students, especially highlighting the increase in involvement in the learning processes. Based on this premise, their study proposes a favorable approach towards gamification in distance education, highlighting its contributions in terms of stimulating motivation, promoting immersion and commitment, and facilitating and socialization, noting that this is accomplished by employing interactive strategies, using immersive narratives to evoke emotions, and promoting interaction in virtual educational environments.

In addition, according to Morales (2022), student participation in active methodologies, where the game stands out for consolidating learning, is motivating. The integration of gamification, especially when mediated by Information and Communication Technologies (ICT), not only reinforces the learning process but also drives the development of digital skills. Being immersed in environments where the game becomes an educational tool, the student feels even more attracted, naturally incorporating ICT into their daily routine, almost inevitably. This approach not only enhances the learning experience but also facilitates the adoption and mastery of digital skills essential for today's environment.

As has been mentioned, the incorporation of recreational elements, or gamification, in the educational field provides clear evidence of the significant benefits that these can have in the students' learning process. This approach not only increases students' involvement and participation in their education but also promotes a series of psychosocial and cognitive aspects essential for effective learning. Among these, motivation, immersion in the content, and commitment to the educational process stand out as fundamental for the student's academic and personal development.

Incorporating interactive strategies, gamification, and immersive narratives allows you to create a more attractive and exciting educational environment, which in turn facilitates the retention of information and meaningful learning. Narrative and interaction not only capture the student's attention but also stimulate their imagination and creativity, promoting a deeper and more reflective approach to the study material.

Furthermore, socialization is another crucial aspect fostered by gamification in educational environments. By promoting interaction within virtual educational environments, the construction of a learning community is facilitated where students can share experiences, doubts, and knowledge. This social

dimension of learning is particularly valuable in education offered outside of school, where isolation can be a significant challenge.

Given this context, it is essential to consider the use of gamification tools in higher education, regardless of the study modalities or options. These tools not only enrich the learning experience but also prepare students for an increasingly digitalized and gamified world. By integrating gamification into the curricular design, educational institutions can offer a more dynamic and engaging learning experience, better preparing students for the challenges of the 21st century. This approach is inclusive and versatile, able to adapt to various disciplines and learning styles, ensuring that everyone.

Augmented reality in education

Augmented Reality (AR) offers the ability to blend the virtual and real worlds, providing interactive and contextualized experiences. AR is a technology that expands our view of the real environment by incorporating additional computer-generated information, according to the definition of Buitrago in 2015 (cited by Berumen et. al, 2021).

The application of augmented reality has proven to be beneficial for cultivating emerging skills related to the use of ICT, the ability to work in teams, and the exploration of valuable immersive teaching resources in the fields of Social Education and Social Work.

On the other hand, research, such as that carried out by Ruiz in 2011 (mentioned in Cárdenas et. al, 2018), demonstrates how Augmented Reality (AR) favors education, especially in contexts such as museums, by connecting the environment with the learning. The availability of AR systems on the market enriches the didactic value of different initiatives, such as the APRENDA project of the Polytechnic University of Valencia, the BIG-BANG 2.0 program of Virtualware to promote digital teaching material, and Magic Book of the Human Interface group Technology Laboratory in New Zealand, which combines physical books with virtual content, likewise, the convergence between the advancement of AR and mobile devices has given rise to innovative educational experiences, exemplified by the 'Mosaic Learning' project. This project investigates how ICT transforms traditional learning, highlighting student demand for technologically advanced educational proposals (Fombona et. al, 2012, cited in Cárdenas et. al, 2018).

The inquiry and constructivist perspectives imply that AR not only offers passive information but invites students to explore, question, and construct their knowledge. Ubiquity, in this context, suggests that AR can be naturally integrated into diverse environments, offering learning opportunities anywhere, anytime.

Furthermore, as pointed out by Cabero-Almenara et. al (2021) augmented reality is available through applications that can be installed on smartphones and tablets. This allows students to be independent when using it and allows teachers to academically use the devices that their students bring with them to university classrooms.

Augmented reality is presented as a powerful educational tool that goes beyond improving the information available. By cultivating practical skills, encouraging exploration, and promoting constructivist and inquiry pedagogical approaches, AR can play a critical role in the evolution of education toward more interactive, contextualized, and meaningful experiences.

METHODOLOGY

The main objective of this research is to examine the usability of an application that combines gamification and augmented reality, intended to enhance learning in Digital Marketing. In more detail, specific aspects such as user satisfaction, memory retention, error rate, and the learning process were evaluated, all of them in relation to the ease of use of the tool. The research approach was descriptive and mixed, conducted on-site with non-experimental control of the variables under a transversal scheme (Ortiz García et al., 2006).

The selected population was students from two groups who studied the Digital Marketing subject at a Mexican public university; during their class in May 2023, he was given access to the application. For the sample, because the elements of the sample are known and according to Spiegel and Stephens (2007), simple random sampling was used for a finite population, where the formula is considered:

$$n = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + (\frac{z^2 \times p(1-p)}{e^2 N})}$$

It must be considered that n represents the sample, p the population, and z the confidence level score, which was defined at 95% and a margin of error of 5%.

The population studied included 83 students from the Universidad Veracruzana, Xalapa campus, distributed into two groups of bachelor's degree students who studied Digital Marketing. Of these, 35 belonged to the administrative computer systems major, and 48 were active students of the bachelor's degree in business management and direction. The final sample for the study was set at 69 students.

To carry out the study, a Systems Usability Scale (SUS) questionnaire was used to evaluate the application in the testing phase, considering the software life cycle. The instrument used allows usability and user experience to be evaluated (Lewis and Sauro, 2009).

The SUS is a standardized tool that has 10 items and answers established on a Likert scale with 5 different options. The items are classified through 5 dimensions that are: Learning, efficiency, memorability, error rate, and satisfaction (Nielsen and Mack, 1994). Based on what was proposed by Ruiz Ledesma et al (2022), the following questionnaire in table 1 is proposed where, to evaluate whether the application had a direct impact on reinforcing knowledge, an additional item was added.

Table 1. Item, dimensions, and instrument options based on SUS.

Dimension	Item	Score option
Satisfaction	I would really like to use these types of applications more frequently.	5 - Totally agree 4 - Agree 3-Neither agree nor disagree 2 – Disagree 1 – Totally disagree
Memorability	I find the app unnecessarily complex.	1 - Totally agree 2 - Agree 3 - Neither agree nor disagree 4 – Disagree 5 – Totally disagree
Memorability	I thought the app was easy to use.	5 - Totally agree 4 - Agree

		3- Neither agree nor disagree 2 – Disagree 1 – Totally disagree
Error	I think I'm going to need technical support to be able to use this App.	1 - Totally agree 2 - Agree 3 - Neither agree nor disagree 4 – Disagree 5 – Totally disagree
Learning	I found the functions in the app well-integrated.	5 - Totally agree 4 - Agree 3- Neither agree nor disagree 2 – Disagree 1 – Totally disagree
Error	I think there were many inconsistencies in the App.	1 - Totally agree 2 - Agree 3 - Neither agree nor disagree 4 – Disagree 5 – Totally disagree
Learning	I imagine that most people could quickly learn to use the application.	5 - Totally agree 4 - Agree 3- Neither agree nor disagree 2 – Disagree 1 – Totally disagree
Satisfaction	Find the app very annoying to use.	1 - Totally agree 2 - Agree 3 - Neither agree nor disagree 4 – Disagree 5 – Totally disagree
Satisfaction	I feel very secure using the app.	5 - Totally agree 4 - Agree 3- Neither agree nor disagree 2 – Disagree 1 – Totally disagree
Learning	I feel like I will need to learn a lot of things before I can use the app.	1 - Totally agree 2 - Agree 3 - Neither agree nor disagree 4 – Disagree 5 – Totally disagree
Knowledge reinforcement	I feel that the application helped me reinforce my knowledge of Digital Marketing topics.	Totally agree Agree Neither agree nor disagree Disagree Totally disagree

Source: own elaboration.
Note. This table shows the 10 items included in the questionnaire applied to the study sample made up of 69 students.

Furthermore, there is a scale against which the result can be compared once the instrument is applied, the responses are added and multiplied by a factor of 2.5 (Derisma, 2020). In Table 2, you can find the qualifications and the corresponding score.

Table 2. Systems Usability Scale Evaluation.

System Usability Scale Evaluation and Qualification	Evaluation Ranges for Systems Usability Scale
Excellent	80.3 >

Well	70 a 80.3
Enough	69
Poor	51 a 68
Very Poor	<51

Source: own elaboration.
Note. This table will display the ranges corresponding to each scale used in the evaluation instrument.

To evaluate the reliability of the study, the Cronbach's Alpha coefficient test was applied using the IBM SPSS software to a pilot test of 40 students, where a value of 0.749 was obtained, considering the questionnaire as reliable and consistent (George and Mallery, 2003).

For the analysis, a descriptive analysis was used through means and standard deviations that allow us to know the distribution of the responses (Teh etal., 2016), as well as the correlation to determine which elements had the greatest impact on the application's final grade. of the application, carried out through the calculation of Pearson's Chi-square as mentioned by Gliner et al. (2002) since they help analyze the relationships between two variables. In both cases, the analyses were done with the support of IBM SPSS software.

Gamification and augmented reality application to reinforce knowledge of the Digital Marketing subject.

The development of the application was develop on the results of a previous study where an instrument was applied to the same sample where three general aspects were analyzed: technology usage, preferred teaching methods, and learning motivation, where the results showed that students have the perception that they learn better through gamification, they frequently use social media filters and rely on smartphones as their primary learning devices (Mejía-Gracia & Hernández García 2024).

The application developed based on the results described was a filter that can be used on Facebook and Instagram, which allows users to interact with the established questions through the smartphone camera. It was determined that the choice of development tool should consider the feasibility of use and that it be easy to access by any student, given that, according to the previous study, practically all students have at least one of the previously mentioned social networks and that they are belonging to the company Meta, which is why it was decided to use the MetaSpark platform for development to generate the augmented reality application as a filter for social networks.

MetaSpark captures and processes data from the real environment using the camera, inertial sensors (such as gyroscopes and accelerometers), and depth sensors in devices such as smartphones. Through computer vision techniques, it detects planes and surfaces, while the SLAM (Simultaneous Localization and Mapping) algorithm oversees geopositioning and mapping the environment in real time. This allows placing virtual objects in the physical space accurately and dynamically, ensuring a seamless integration between the real world and the virtual elements, and no additional software installation is required from the students, beyond their Facebook or Instagram applications.

The tool poses ten questions related to the topics of the subject, in which administration, strategies, tools, and digital marketing plans were considered, in addition to the topic of consumer behavior. The questions have two response alternatives, a distractor, and the correct solution, and are visible via overlay using the front camera of the mobile device.

Table 3. Animations according to results.

Result	Animation
Less than 7 answers	Tears over the eyes
Between 7 and 8	No animation
Greater than 9	Sunglasses over eyes

Source: own elaboration.
Note. In this table, you can see two different types of animations according to the results that the students obtained when using the application.

In table 3, in addition to the result and the phrase, an animation is superimposed according to the score obtained, which promotes the challenge and at the same time has entertaining elements for the student. To carry out this application, MetaSpark AR Studio was used, in which it was considered that the student would interact with the application through the camera of their mobile device. The public access link is the following: *https://acortar.link/eJ1YWf*.

Image 1. Screenshots of application operation.

Source: own elaboration.
Note. This image was created using MetaSpark Studio to show how the generated application works.

For the development of the tool, materials and textures were used to add the question, the answers and sunglasses, and tears for interaction according to the answer. Animation sequences were added for each question, answer, and result, and validations were added through patches that trigger interactions according to the user's responses.

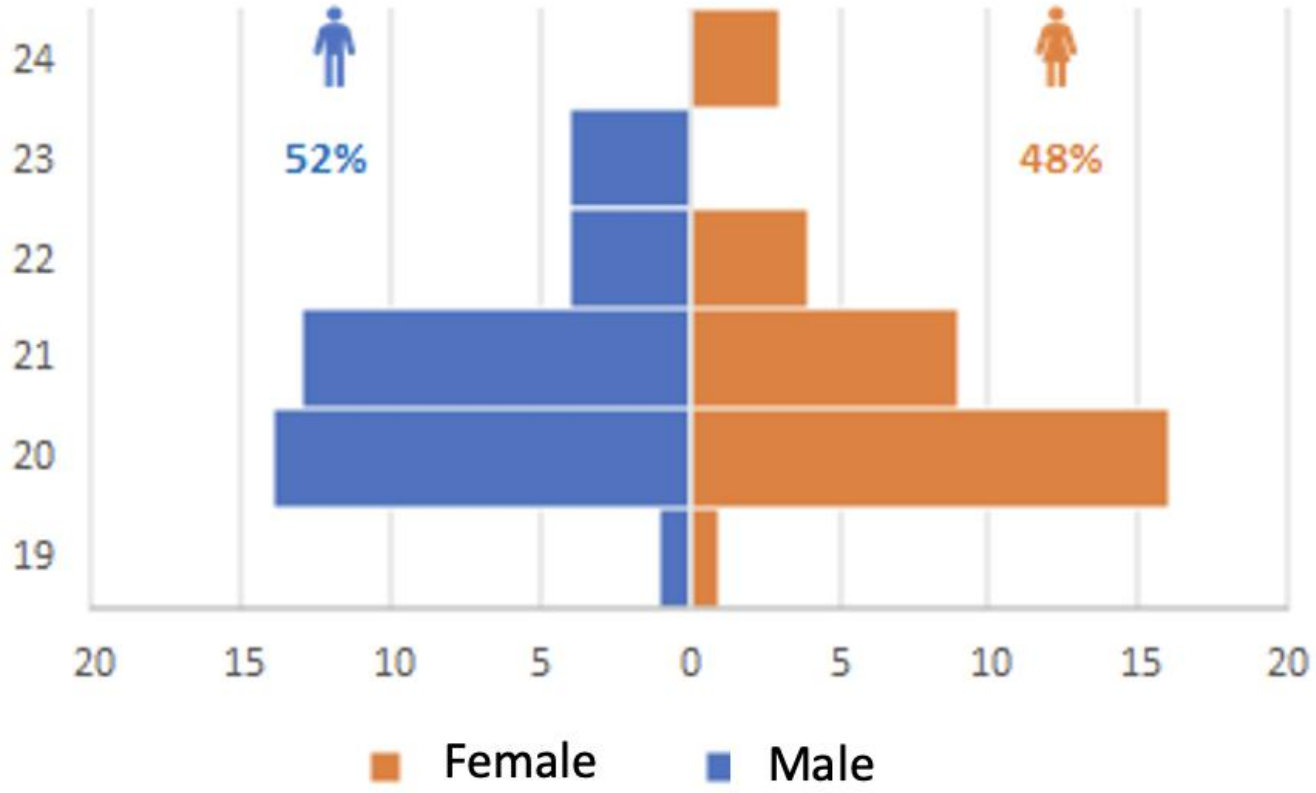
RESULTS

The results presented below come from normality and descriptive analyses, including measures of central tendency, evaluations of the system usability scale, and correlations between variables.

Descriptive analyses

Firstly, tests of normality were applied to the results through the Shapiro-Wilk test, where all items had a result of 0.000, this being less than 0.05, so the responses are not within the normal distribution. Based on the sociodemographic analysis, it was obtained that 47.8% of the respondents identified with the male gender and 52.2% with the female gender (figure 1).

Figure 1. Gender and Age.



Source: own elaboration.
Note. This figure shows the results related to the gender and age of the students who used the application.

In figure 1, it is also seen that 43.5% of the respondents are 20 years old, 31.9%, 21.6%, 22 years old, 5.8%, 23 years old, 4.3%, 24 years old, and in a smaller proportion with 19 years old only 2.9%.

Tabla 4. Degree and cohort.

Degree	Frequency	%	Generation	Frequency	%
Administrative Computing Systems	28	40.6%	2019	1	1.4%
Business Management and Direction	41	59.4%	2020	61	88.4%

Total	69%	100%	2021	7	10.1%
			Total	69	100%

Source: own elaboration.
Note. This table presents the data related to the educational program of affiliation and generation of the students who participated in the study.

In table 4, the respondents belong to the educational program with a degree in Business Management and Management with 59.4%, and the rest 40.6% from the degree program in Administrative Computing Systems. On the other hand, a greater proportion of respondents are 2020 generation with 88.4% compared to 10.1% of 2021 generation students and only 1.4% of 2019 students.

To carry out the descriptive analysis, measures of central tendency were used, including the means and standard deviations. Table 2 presents the results.

Table 5. Means and standard deviations.

Dimension	Item	Mean	Standard Deviation
Satisfaction	I would really like to use these types of applications more frequently.	3.70	1.386
	Find the app very annoying to use.	1.97	1.150
	I feel very secure using the app.	3.72	1.136
Memorability	I find the app unnecessarily complex.	2.54	1.208
	I thought the app was easy to use.	4.01	1.118
Error	I think there were many inconsistencies in the app.	2.32	1.050
	I think I'm going to need technical support to be able to use this app.	2.33	1.325
Learning	I found the functions in the app well-integrated.	4.03	0.970
	I imagine that most people could quickly learn to use the application.	4.14	1.102
	I feel like I will need to learn a lot of things before I can use the app.	2.67	1.280
Knowledge reinforcement	I feel that the application helped me reinforce my knowledge of Digital Marketing topics.	4.00	1.015

Source: own elaboration.
Note. This table presents the means and standard deviations that correspond to the 11 items applied in the questionnaire.

Table 5 shows the items grouped by dimension, where, first, there is satisfaction, where the items refer to the pleasure of using applications of this type more frequently, and the security when using the application, gave a result of 3.70 and 3.72, where it is established that they agree. If the application is annoying to use, the result was 1.97, placing it in disagreement.

In the memorability dimension, in the item, the application was easy to use, the score was 4.01, placing it in the 'Agree' category, and considering that it is unnecessarily complex, the result was more oriented towards neither agree nor disagree 2.54.

In the case of errors, if there was inconsistency in the application and the impression of requiring technical support to use the answers are closer to disagreement, with means of 2.32 and 2.33 respectively.

In the learning dimension, in the item's well-integrated functions and rapid learning in the use of the

application, the responses are 4.03 and 4.14, resulting in agreement. In the question where they did have the perception that they needed to learn many things before using the application, the result was 2.67, placing them in the 'Neither agree nor disagree' category.

Regarding the students' perception of whether the application helped them reaffirm their knowledge of Digital Marketing issues, the average response was 4.0, agreeing.

Systems usability scale

To generate an evaluation of the systems usability scale, the results were transferred to table 3, where the rounded average result corresponding to each item was applied and finally multiplied by the factor established by Derisma (2020).

Table 6. Systems usability scale results.

Dimension	Item	Result	Score
Satisfaction	I would really like to use these types of applications more frequently.	Agree	4
Memorability	find the app unnecessarily complex.	Neither agree nor disagree	3
Memorability	I thought the app was easy to use.	Agree	4
Error	I think I'm going to need technical support to be able to use this app.	Disagreement	4
Learning	I found the functions in the app well-integrated.	Agree	4
Error	think there were many inconsistencies in the app.	Disagreement	4
Learning	I imagine that most people could quickly learn to use the application.	Agree	4
Satisfaction	Find the app very annoying to use	Disagreement	4
Satisfaction	I feel very secure using the app.	Agree	4
Learning	I feel like I will need to learn a lot of things before I can use the app.	Neither agree nor disagree	3
Sum			38
Final result with a factor of 2.5			95

Source: own elaboration.
Note. This table presents the score obtained in each of the dimensions evaluated.

In table 6, the results per item give a score of 4, except for the complexity sections related to memorability and learning about knowing many elements before using them, where the result was 3. The final sum gave 38, and applying the factor, an application rating of 95.

Correlations

In the correlation analysis, contingency tables were made between the item “I feel that the application helped me reinforce my knowledge about Digital Marketing topics” and the other items, and Pearson's Chi-square was calculated to obtain the correlation. Below, Table 7 shows the results with the strongest correlation.

Table 7. Pearson Chi-square tests.

Item	Asymptotic sig.
I thought the app was easy to use.	0.000
I imagine that most people could quickly learn to use the application	0.000

Source: own elaboration.
Note. This table shows the items that had the highest correlation according to Pearson's Chi-square tests.

It is important to note that correlation analyses were carried out between all the items; however, significant relationships were only found between the items: "I thought the app was easy to use" and "I imagine that most people could quickly learn to use the application." Hence, they are the only contingency tables that will be presented.

As shown in table 7, a stronger correlation was obtained between the elements “I think the application was easy to use” and “I imagine that most people could quickly learn to use the application”, with the asymptotic being 0.000. The results for the related items are shown below.

Table 8. Contingency table 1.

		I feel that the application helped me reinforce my knowledge about Digital Marketing topics					
I thought the app was easy to use		Totally disagree	Disagree	Neither agree nor disagree	Agree	Totally agree	Total
	Totally disagree	1.4%	1.4%	0 %	1.4%	1.4%	5.8%
	Disagree	1.4%	2.9%	0 %	0 %	0 %	4.3%
	Neither agree nor disagree	0 %	1.4%	7.2%	1.4%	2.9%	13%
	Agree	0 %	0 %	1.4%	23.2%	11.6%	36.2%
	Totally agree	0%	0 %	7.2%	13%	20.3%	40.6%
	Total	2.8%	5.7%	15.8%	39%	36.2%	100%

Source: own elaboration.
Note. The table shows the relationship that exists between the items of ease of use and knowledge reinforcement.

Table 8 shows that the highest values are "Agree" in both statements, with 23.2%, and "Totally agree" in 20.3%, and 13% with "Agree" in knowledge reinforcement and "Totally agree" in ease of use. Although the distribution between the items "I feel that the application helped me reinforce my knowledge about Digital Marketing topics" and "I think the application was easy to use," where 76.8% agree. Agree or totally agree that it was easy to use, and 75.2% agreed that it helps reinforce the corresponding knowledge.

Table 9. Contingency table 2.

I feel that the application helped me reinforce my knowledge about Digital Marketing topics							
		Totally disagree	Disagree	Neither agree nor disagree	Agree	Totally agree	Total

I imagine that most people could quickly learn to use the application	Totally disagree	1.4%	4.3%	0 %	0%	0%	5.8%
	Disagree	1.4%	0%	0 %	1.4 %	0 %	2.9%
	Neither agree nor disagree	0 %	1.4%	4.3%	1.4%	2.9%	13%
	Agree	0 %	0 %	8.7%	18.8%	5.8%	36.2%
	Totally agree	0%	0 %	2.9%	17.4%	27.5%	40.6%
	Total	2.8%	5.7%	15.9%	39%	36.2%	100%

Source: own elaboration.
Note. The table shows the relationship that exists between the learning items in the use and reinforcement of knowledge.

In the case of the items “I feel that the application helped me reinforce my knowledge about Digital Marketing topics” and “I imagine that most people could quickly learn to use the application” in Table 9 it can be seen that 76.8 % consider that they agree or totally agree about the rapid learning to use the tool and 75.2 also partially or totally agree that it helped them reinforce knowledge. The highest values being 18.8% in "Agree", 27.5% in "Totally agree", and 17.4% in "Agree" in knowledge reinforcement and "Totally agree" in quickly learn.

According to the correlations, the key points are that the perception of ease of use and quick learning of the tool are key factors for reinforcing knowledge.

CONCLUSIONS AND DISCUSSION

This study reveals key aspects of the usability and effectiveness of an augmented reality (AR) application designed for digital marketing education. Highlighting that the application appears to be intuitive and easy to use, as indicated by the high scores on the items related to ease of learning and integration of functions, with means of 4.03 and 4.14, respectively. Users perceive that they can learn to use the application quickly and that they will not need advanced computer knowledge to use it, which is evident in the low average score of 2.67 for the need to learn many things before being able to use the application. These positive results on usability suggest that the application of AR could be an effective resource in improving the teaching-learning process in digital marketing, facilitating broader access and better retention of knowledge without the need for advanced technical skills.

The above is aligned with what was obtained by Rodríguez López et al. (2023), who mention in their study that the incorporation of augmented reality to reinforce the teaching of the English language increases the motivation of students, making them more interested in learning and using these tools as teaching material.

On the other hand, participants feel that the application has contributed positively to strengthening their knowledge in digital marketing, with an average of 4.00. This suggests that AR can be an effective tool to improve understanding of digital marketing concepts.

Regarding satisfaction, users indicate a moderate interest in using this type of application more frequently, with an average of 3.70, and they feel safe when using it, with an average of 3.72. The result is corroborated by what was established by Martín-Gutiérrez, et al. (2015), who established that augmented

reality tools strengthen learning satisfaction.

According to the results shown in Table 6, referring to the systems usability scale, a total evaluation of 95 is perceived, which is interpreted through what is established in Table 2, proposed by Derisma (2020). The usability of the augmented reality gamification application is excellent.

An excellent result in the evaluation of the usability of the application has a positive impact on student learning; Xu and Wu (2011) also agree, showing reliability in the use of the application in issue (Orfanou, K., Tselios, N., and Katsanos, C., 2015)

The elements that had the greatest impact on the effectiveness of the tool to reinforce knowledge about digital marketing were the ease of use and the speed of learning to apply it immediately, as indicated by the data in tables 7, 8, and 9, where the evaluation is positive for more than 70% of the students and there are strong correlations.

At the university level, the study was carried out by Romero Saritama, J. M., Cabero Almenara, J., & Gallego Pérez, Óscar. (2023) where they determined that the students reinforced their knowledge of the topic, as well as valued it as interesting, innovative, and fun, having participated in the experience of using augmented reality, which corresponds with the acceptance and correlations between the ease and speed in use with digital marketing learning.

Likewise, the results of our research coincide with those of Rivadulla López, J. C., & Rodríguez Correa, M. (2020), who reached the conclusion, after implementing in a school, and with a sample of several teachers and students, in a controlled study, that augmented reality is a tool that increases the motivation of students, improves the training action of students, conclusion similar to that of Marrahí-Gómez and Belda-Medina (2022), who carried out and applied a study with reality augmented for teaching the English language, similar to (Rodríguez López, Becerra Auz, & Ulloa Meneses, 2023).

To strengthen the use and effectiveness of these educational tools in the future, it will be crucial to pay attention to friction points and work to improve the user experience. User satisfaction is a critical component that can influence the adoption and long-term use of Augmented Reality technology in educational environments. Therefore, it is essential to focus on understanding and improving these aspects to ensure the effective integration of AR into educational practice. Regarding the perceived complexity of the application, users rate it as unnecessarily complicated, with an average score of 2.54, which could indicate an opportunity to simplify the interface or improve the user experience.

In conclusion, the results of the study support the claim that AR is a promising tool for digital marketing education and is evaluated as excellent in its usability, highlighting its ease of use and its ability to reinforce learning. The positive disposition of users towards the adoption of this technology reinforces its viability as a pedagogical resource. However, it is important to address criticisms related to the complexity of the application to optimize the user experience. Future developments in AR applications should prioritize simplifying user interfaces to maximize their educational impact.

Finally, it is stated that Augmented Reality stands out as a technology with great didactic and motivating potential in education, capable of enriching learning processes and arousing the interest of students of different educational levels and that it is not restricted to a particular area of knowledge, but it cannot be applied in a multidisciplinary approach; however, positive levels of usability are essential for the effectiveness of the tool. As future lines of study, the tool can be applied to other academic disciplines to

evaluate its benefits and, if possible, extend its relevance and applicability.

DECLARATION OF CONFLICT OF INTEREST

We declarate that during the execution of the work or writing of the article, we have not been affected by personal interest or interest beyond our control.

BIBLIOGRAPHIC REFERENCES

1. Aldalur, I., & Perez, A. (2023). Gamification and discovery learning: Motivating and involving students in the learning process. Heliyon, 9(1), e13135. https://doi.org/10.1016/j.heliyon.2023.e13135

2. Alonso, M., & Santander-Castillo, J. (2021). Implementación de realidad aumentada en aplicaciones móviles en la educación superior: retos y oportunidades: Implementation of augmented reality in mobile applications in higher education: challenges and opportunities. Tecnología Educativa Revista CONAIC. 8. 76-80. 10.32671/terc.v8i1.197.

3. Ausín,V., Rodríguez, S., Delgado, V., & Toma, R. B. (2023). Evaluación de una APP de realidad aumentada en niños/as con dislexia: estudio piloto: [Evaluation of an augmented reality APP for children with dyslexia: a pilot study]. Pixel-Bit. Revista De Medios Y Educación, 66, 87–111. https://doi.org/10.12795/pixelbit.95632

4. Berrones-Yaulema, L. P., Tapia-Brito, D. Y., Bautista-Samaniego, J. A., & Moposita-Vásquez, D. D. (2023). Explorando el aprendizaje ubicuo: Características, desafíos y experiencias en la era digital. Dominio de las Ciencias, 9(3), 1875-1895. https://doi.org/10.23857/dc.v9i3

5. Berumen, E., Acevedo, S., & Reveles, S. (2021). Realidad aumentada como técnica didáctica en la enseñanza de temas de cálculo en la educación superior. Estudio de caso. RIDE Revista Iberoamericana Para La Investigación Y El Desarrollo Educativo, 11(22). https://doi.org/10.23913/ride.v11i22.890

6. Boytchev, P.& Boytcheva, S. (2020). Gamified Evaluation in STEAM for Higher Education: A Case Study. Information, 11(6), 316. https://doi.org/10.3390/info11060316

7. Cabero-Almenara, J., Vázquez-Cano, E., Villota-Oyarvide, W.R., & López-Meneses, E. (2021). La innovación en el aula universitaria a través de la realidad aumentada. Análisis desde la perspectiva del estudiantado español y latinoamericano. Revista Electrónica Educare, 25(3), 1-17.

8. Cárdenas, H.A., Mesa,F.Y., & Suárez, M.J. (2018). Realidad aumentada (RA): aplicaciones y desafíos para su uso en el aula de clase. Educación y Ciudad, 35, 137-148. https://doi.org/10.36737/01230425.v0.n35.2018.1969

9. Cuba, E.B.,& Pérez, I. (2021). Aplicación de la gamificación en el diseño de actividades en la Educación a Distancia. Revista Cubana de Ciencias Informáticas, 15, 366-380. https://www.redalyc.org/journal/3783/378370462022/html/

10. Derisma, D. (2020) The Usability Analysis Online Learning Site for Supporting Computer programming Course Using System Usability Scale (SUS) in a University. International Journal of Interactive Mobile Technologies, 14(9).

11. Dorta, D., & Barrientos, I. (2021). La realidad aumentada como recurso didáctico en la enseñanza superior. Revista Cubana de Ciencias Informáticas, 15(4,1), 146-164. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2227-18992021000500146&lng=es&tlng=es.

12. George,D. & Mallery, P. (2003). SPSS for Windows step by step: A Simple Guide and Reference. 11.0 Update (4th ed.). Allyn and Bacon.

13. Gliner, J. A., Morgan, G. A., & Harmon, R. J. (2002b). The Chi-Square Test and Accompanying Effect Size Indices. Journal Of The American Academy Of Child And Adolescent Psychiatry, 41(12), 1510-1512. https://doi.org/10.1097/00004583-200212000-00024

14. Guzmán-Rivera, M.A., Escudero-Nahón, A., & Canchola-Magdaleno, S.L. (2020). “Gamificación" de la enseñanza para ciencia, tecnología, ingeniería y matemáticas: cartografía conceptual.Sinéctica. 54, 1-20. Doi: 10.31391/S2007-7033(2020=0054-002.

15. Kolb , A. Y. ., & Kolb , D. A. (2022). Experiential Learning Theory as a Guide for Experiential Educators in Higher Education. Experiential Learning and Teaching in Higher Education, 1(1), 38. https://doi.org/10.46787/elthe.v1i1.3362

16. Lewis, J. R. & Sauro, J. (2019). Item Benchmarks for the System Usability Scale Item Benchmarks for the System Usability Scale. Journal of Usability Studies, 13 (3), 158 -16

17. Marrahí-Gómez, V. & Belda-Medina, S. (2022). The Application of Augmented Reality (AR) to Language Learning and its Impact on Student Motivation. International Journal of Linguistics Studies, 2(2), 07–14. https://doi.org/10.32996/ijls.2022.2.2.2

18. Martín-Gutiérrez, J., Fabiani, P., Benesova, W., Fernández, M., & Luis, C. (2015). Augmented reality to promote collaborative and autonomous learning in higher education. Comput. Hum. Behav., 51, 752-761. https://doi.org/10.1016/j.chb.2014.11.093.

19. Mejía-Gracia, C. A.& Hernández-García, R. A. (2024). Análisis descriptivo y paramétrico de la gamificación con realidad aumentada como estrategia para potenciar la motivación estudiantil en una

asignatura de educación superior. Revista de Educación, 48(2). http://doi.org/10.15517/revedu.v48i2.55969

20. Morales, R. E. (2022). La gamificación como estrategia de evaluación bajo el enfoque flipped learning. RIDE Revista Iberoamericana Para La Investigación Y El Desarrollo Educativo, 13(25). https://doi.org/10.23913/ride.v13i25.1296

21. Nielsen, J., & Mack, R. L. (1994). Usability inspection methods. New York: Wiley. Organisation for Economic Co-operation and Developmen [OECD]. (2016). Low Performing Students: Why They Fall Behind and How To Help Them Succeed. Paris, France: OECD Publishing. Retrieved from https://www.oecd-ilibrary.org/education/low -performing-students_9789264250246-en

22. Olivo E., Moreno, R, & Mondragón, R. (2023). Gamificación y aprendizaje ubicuo en la educación superior: aplicando estilos de aprendizaje. Apertura (Guadalajara, Jal.), 15(2), 20-35. https://doi.org/10.32870/ap.v15n2.2408

23. Orfanou, K., Tselios, N., & Katsanos, C. (2015). Perceived usability evaluation of learning management systems: Empirical evaluation of the System Usability Scale. The International Review of Research in Open and Distributed Learning, 16, 227-246. https://doi.org/10.19173/irrodl.v16i2.1955.

24. Ortiz, J. M., N, E. J., & Escudero, J. (2006). Guia descriptiva para elaborar protocolos de investigación. Revista Salud En Tabasco, 12(3).

25. Pérez-López, I., & Navarro-Mateos, C. (2022). Gamificación: lo que es no es siempre lo que ves. Sinéctica, (59), e1414.https://doi.org/10.31391/s2007-7033(2022)0059-002

26. Riccetti, A, Franco, E, Coterón, J., & Gómez, V. (2021). Estado de flow e intención de práctica de actividad física en adolescentes argentinos. Revista de Psicología (PUCP), 39(1), 289-310. https://doi.org/10.18800/psico.202101.012

27. Rivadulla , J. C., & Rodríguez, M. (2020). La incorporación de la realidad aumentada en las clases de ciencias. Contextos Educativos. Revista De Educación, (25), 237–255. https://doi.org/10.18172/con.3865

28. Rodríguez, M. A., Becerra, A. F., & Ulloa, L. J. (2023). Aplicación de realidad aumentada como herramienta de apoyo para el aprendizaje del idioma inglés. Pontificia Universidad Católica del Ecuador-sede Santo Domingo. https://dialnet.unirioja.es/servlet/articulo?codigo=8804809

29. Romero, J. M., Cabero, J., & Gallego, Óscar. (2023). Realidad Aumentada como recurso didáctico para el aprendizaje de Biología: un estudio exploratorio desde la percepción de los estudiantes universitarios.

Edutec. Revista Electrónica De Tecnología Educativa, (84), 52-69. https://doi.org/10.21556/edutec.2023.84.2867

30. Ruiz, E. F., Chavarría, L., & Viveros, K. (2022). Aplicación móvil como apoyo en la práctica de la destreza operatoria aritmética de estudiantes de secundaria. RIDE Revista Iberoamericana Para La Investigación Y El Desarrollo Educativo, 13(25). https://doi.org/10.23913/ride.v13i25.1235

31. Salinas, J., De Benito, B., Pérez, A., &, M. (2018). Blended learning, más allá de la clase presencial. RIED-Revista Iberoamericana de Educación a Distancia, 21(1), 195–213. https://doi.org/10.5944/ried.21.1.18859

32. Sobrino-Morrás, Á., (2014). Aportaciones del conectivismo como modelo pedagógico post-constructivista. Propuesta Educativa, (42), 39-48. https://www.redalyc.org/articulo.oa?id=403041713005

33. Teh, S. Y., Othman, A. R., Sulaiman, S., Mohamed–Ibrahim, M. I., & Razha-Rashid, M. (2016). Application of mean and standard deviation in questionnaire surveys: Construct validation. Jurnal Teknologi, 78(6-4). https://doi.org/10.11113/jt.v78.8983

34. Spiegel, R., & Stephens, J. (2007) Schaum's Outline of Statistics. McGraw-Hill.

35. Xu, M., & Wu, T. (2011). Study on learning process orientation through learning performance. 2011 2nd International Conference on Artificial Intelligence, Management Science and Electronic Commerce (AIMSEC), 4788-4791. https://doi.org/10.1109/AIMSEC.2011.6010326.