Virtual Education Through E, B and M Learning: A Systematic Review of the Literature Between 2008-2022

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Abstract

The research aimed to understand the benefits of using application tools in the academic performance of university students, regarding the role of virtual education and how it positively influences the academic performance of future engineers. On the other hand, it was carried out research in different reliable sources, having principles like Scopus, Scielo, Dialnet, Redalyc, and DOAJ; using the following keywords: academic performance, higher education, M-learning engineering education, Online learning, E-learning, Machine learning, Distance learning, Methodology, and cooperative learning. Likewise, inclusion and exclusion criteria were applied to the aspects, taking into account the study title of the variable, year of publication, language, type of research, open–access study, quantitative results, etc. Meanwhile, in bibliometric results was evident that the use of mobile devices during distance education has improved academic performance and gained broader and more effective knowledge. During the last years, there has been an increase in original articles regarding academic performance, of the recognized studies, 59% were in English and 41% in Spanish, simultaneously Scopus, DOAJ, and Redalyc have had the highest number of researches on the subject. In the results of the content, it was found educational methods related to E-learning, B-learning, and M-learning that were reduced with their implementation. In conclusion, virtual learning as E-learning contributes to engineering students achieving good performance by helping them learn more efficiently and effectively.

Keywords

Academic performance, higher education, distance learning, and virtual learning.

1. Introduction

In recent years, technology has been undergoing a favorable change in the educational system and in the training of engineering students who are arriving at universities, now known as digital natives, those from Generation Y or Millennials [1]. Additionally, according to portions of the theoretical framework presented at the International Conference on University Teaching and Learning published in “Select Papers”, a study was conducted involving 130 researchers studying at the GEFT, where the following profile was identified: 99 (76%) Analytical, 25 (19%) Medium, and 6% (5%) Global. Subsequently, it was concluded that in the Analytical and Medium categories, a significantly passing score was achieved, interpreted by the faculty as an above-average grade [2].

Nevertheless, the application of mobile technologies in education, known as "m-learning," is breaking the traditional teaching-learning binary by incorporating more dynamic pillars such as immediate access to knowledge, collaborative work, or personalized learning. This has highlighted the favorable and beneficial impact of technological development in improving educational tools, moving from traditional methods to more innovative and different approaches. Furthermore, it has enabled users to overcome the barriers of traditional learning to generate

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more complex and dynamic knowledge, allowing for the interconnection of ideas and the proposal of solutions to everyday problems [3].

Therefore, the use of smartphones represents a new tool and challenge for the educational field in three dimensions: spatial, temporal, and social. These devices offer benefits in developing competencies in higher education. Observation of the use of these tools indicates potential for speed, in addition to simplifying the incorporation of virtual identities and interaction with advanced educational platforms by managing data and enabling integration into real-time networks. This offers more optimal and effective learning [4]. In other words, to gain a deeper understanding of didactic models, study habits, and their influence on the academic performance of university students, it is also necessary to refer to theoretical foundations. This includes didactic design, which involves the process a teacher follows to plan a course within the curriculum of the academic unit. This encompasses the institutional and academic context and the characterization of students, as well as the selection of teaching strategies, including the design of the didactic model to help students achieve good academic performance [5].

In this regard, online education, distance learning, and the emergence of various digital services and tools have determined the relevance and necessity for university teachers to develop electronic educational resources of their own authorship. This enables the implementation of educational programs, even in the context of interaction limitations during the pandemic [6].

2. Methodology

For the development of the present research, it has been proposed to develop a systematic literature review with a quantitative approach taking into account the topic of virtual education as a way to improve academic performance in higher institutions. As mentioned above, the systematic literature review is described as a set of orderly and documented steps aimed at providing a critical and comparable synthesis of the results obtained in the analysis of the included studies in order to answer the research questions proposed by the authors. In this sense, SLRs (Systematic Literature Reviews) give rise to the quick analysis of the knowledge stored in different databases on a specific topic in order to make decisions. It also seeks to respond to the weaknesses detected in the subject, as well as to identify the possible strengths of the methods found, in order to carry out a discussion to generate new knowledge for the scientific community. In the last few years, the resources available to improve search methods for quality scientific manuscripts have been limited [7].

This article used a method known as PRISMA, designed for those who conduct systematic reviews of research, to design transparent and understandable reports. In the same way, it allows planning, preparing, publishing, aiming to publish better quality methodologies and results. (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) or PRISMA is a set of "Preferred Reporting Items for Systematic Reviews and Meta-Analyses". This approach contains sequence steps that allow designing a structure on a specific topic or author's preference, and complete articles where a complete picture should be obtained for their choice, on the other hand, individual studies have to meet rigorous criteria of eligibility and can fit in one or more articles [8].

In the last few years, with the coming of new concepts and methodological aspects of systematic review methods, it is worth mentioning that with the application of PRISMA, there have been significant achievements in terms of its evaluation and research [9]. In summary, it is a favorable technique for organizing and implementing systematic reviews for the purpose of a collection of excellencies with respect to the data provided. [10].

As part of the research, the following aspects belonging to the PRISMA method were taken into account: aspects of inclusion, search strategy, and sources of information. Different databases including Scopus, Doaj, Scielo, Dialnet, and Redalyc were consulted to get information. As for the search strategies, the term "E, B, M-learning" was used in the areas of Article, Title, Abstract, and Keywords, defining the date range between 2008 and 2022. A total of 200 downloaded records were reviewed, with 72 in Spanish, 123 in English, and 5 in Portuguese.

In addition, specific performance measures such as the amount of work produced in a year, the amount of work produced by each author, and the efficiency in terms of keywords were analyzed. To carry out this analysis, the following key terms were used: academic performance, higher education, M-learning, engineering education, online learning, E-learning, B-learning, Machine Learning, and distance learning.

It started by searching for the proposed study, using descriptions for inclusion and exclusion to reduce the number of articles as much as possible. The following is the first table.

Table1
Criteria applied for study selection

C1	Both the abstract and the title include one or all the variables.
C2	The keywords are related to the variables of the study.
C3	On the review, the date of publication indicates the period corresponding to the study.
C4	The language used relates to the languages used in the study.
C5	The country of the study corresponds to the delimitation of the review.
C6	The study is available in Open Access.
C7	The results obtained from the study are of an application and empirical way.
C8	The article contains tools that are part of engineering.
C9	The study is diligent towards an institution, company, and organization.
C10	The quantitative indicators of the study demonstrate a replicable effect.

Note: The criteria were established based on the authors' considerations. In the results stage, 2 segments were composed: the bibliometric analysis (title, author, year, country, language, keywords, institutional affiliation) and an engineering content analysis (effects and application tools).

3. Results

The bibliometric results in E, B, and M-Learning virtual education allowed the identification of related aspects of engineering.

3.1. Bibliometric results

Table II presents the information considered: authors' surnames and titles of the research studies.

Table2
Articles included in the systematic review based on virtual education through e, b, and m -learning: a systematic review of the literature: during 2008-2022

Authors	Title of research
Cao (2022) [11]	Learning Quality Evaluation of Course Implementation Supported by Online Teaching Platform
Chaikovska et al. (2022) [12]	Career-focused esp learning through mechanical engineering android app and fe prep flashcards
Durán, Costaguta y Gola (2011) [13]	El modelo b-learning implementado en la asignatura simulación
España et al. (2013) [14]	Project-based learning: application to a research master subject of thermal engineering
Tan y Shao (2015) [15]	Prediction of student dropout in E-learning program through the use of machine learning method
Deng y Li (2021) [16]	A Hadoop-Based Online Teaching Model of "VisibleBody"

Saleem et al. (2021) [17]	Intelligent decision support system for predicting student's e-learning performance using ensemble machine learning
Akram et al. (2019) [18]	Predicting Students' Academic Procrastination in Blended Learning Courses Using Homework Submission Data
Callejón, López y Carreño (2010) [19]	Adaptación y desarrollo de la asignatura Motores y máquinas de la titulación de Ingeniero Técnico Agrícola en Industrias Agrarias y alimentarias ante el Espacio Europeo de Educación Superior
Kumar et al. (2022) [20]	Mobile Learning Acceptance Post-Pandemic: A Behavioural Shift among Engineering Undergraduates
Domínguez et al. (2019) [21]	The effects of adding non-compulsory exercises to an online learning tool on student performance and code copying
Jiao et al. (2022) [22]	Artificial intelligence-enabled Prediction model of student academic performance in online engineering education
Molina-Cabello et al. (2022) [23]	Are learning styles useful? A new software to analyze correlations with grades and a case study in engineering
Bakri, Salwani y Mohd (2016) [24]	Designing an Integrated Teaching and Learning of Mathematics and Image Processing in Engineering Technology
Demian y Morrice (2012) [25]	The use of virtual learning environments and their impact on academic performance
Sandoval (2013) [26]	Propuesta para implementar un sistema de gestión del conocimiento que apoye el diseño de un curso online
Pertuz et al. (2017) [27]	Lineamientos para el diseño de Cursos Online Masivos y Abiertos (MOOC) en Ingeniería Electrónica
Claros-Perdomo et al. (2020) [28]	Uso de la realidad aumentada, gamificación y m-learning
Sotelo-Castillo et al. (2022) [29]	Perceived learning of University students in face-to-face and B-learning courses: a comparative study
Dung y fatmawati (2018) [30]	General informatics teaching with B-learning teaching model
Suárez, Jiménez y Bonilla (2017) [31]	Uso de escenarios de aprendizaje en entornos E-Learning y B-Learning como alternativa de estudio en la educación a distancia
Martín-Gómez y Masa-Lorenzo (2017) [32]	Aprendizaje m-learning en la materia Dirección de la Producción mediante flipped classroom con entornos colaborativos virtuales y su evaluación con rúbricas
Donnell (2014) [33]	Using M-learning as a Means to Promote Self-direction and Engagement in Apprenticeship Theoretical Lessons
Fuente, Morales y Montoya (2018) [34]	M-learning y desarrollo de habilidades digitales en educación superior a distancia
Yildiz et al. (2020) [35]	Research Trends in Mobile Learning
Al Masarweh y Afandi (2022) [36]	Investigating Factors M-Learning Acceptance and Use for Distance Learning Students in Higher Education
Casanovas (2021) [37]	El reto de los dispositivos móviles en las aulas universitarias: una respuesta actual al trabajo autónomo y a la evaluación virtual
Gómez-Álvarez, Echeverri y González-Palacio (2017) [38]	Estrategia de evaluación basada en juegos: Caso Ingeniería de Sistemas Universidad de Medellín
Domínguez et al. (2008) [39]	Modalidad de curso semipresencial. aplicación en la asignatura procesos tecnológicos

Miljković, Petojević y Ažižović (2016) [40]	Monitoring the effect of motivation on mastering knowledge and skills in distance learning systems
Durán y Costaguta (2008) [41]	Experiencia de Enseñanza Adaptada al Estilo de Aprendizaje de los Estudiantes en un Curso de Simulación
Bhardwaj et al. (2021) [42]	Application of Deep Learning on Student Engagement in E-learning Environments

Note: The criteria have been established based on the authors' considerations

In Figure 1, it is seen that the highest number of articles published is between the years 2008 and 2022, with 21.9%. The years 2010, 2011, 2012, 2012, 2014, and 2015 have the least number of publications, with only 1.

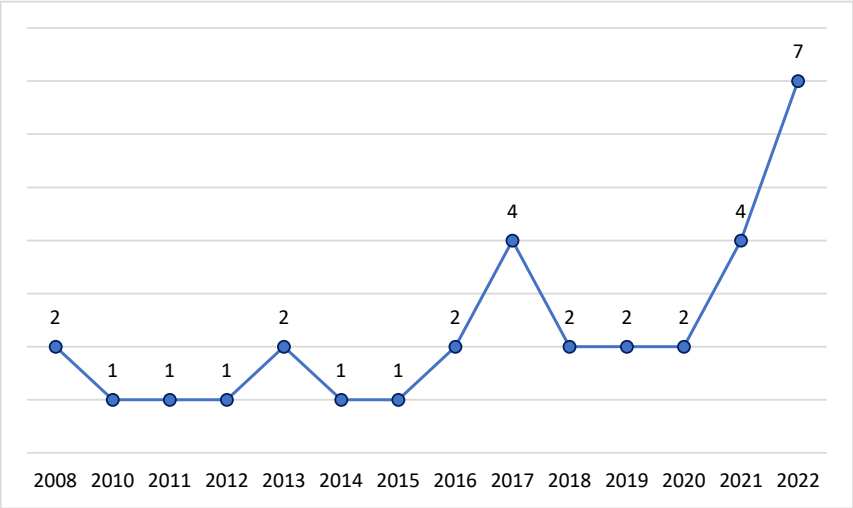

Figure. 1 Articles included in the systematic review are classified based on the year of publication

In Figure 2, the highest number of publications is located in Spain, which has 7, while Colombia, Malaysia, and Ukraine have the same number of publications.

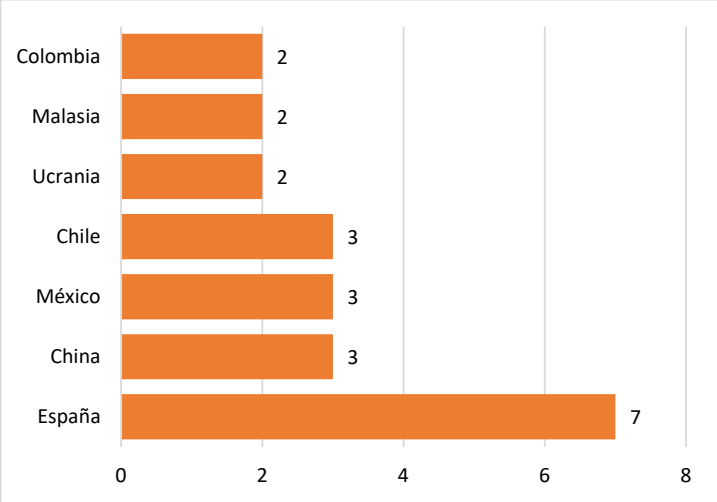

Figure. 2 Articles included in the systematic review are classified as a result of countries or regions.

In the following image, it can be observed that 41% of the articles are in Spanish, that is 13, while 50% are in English, for a total of 19.

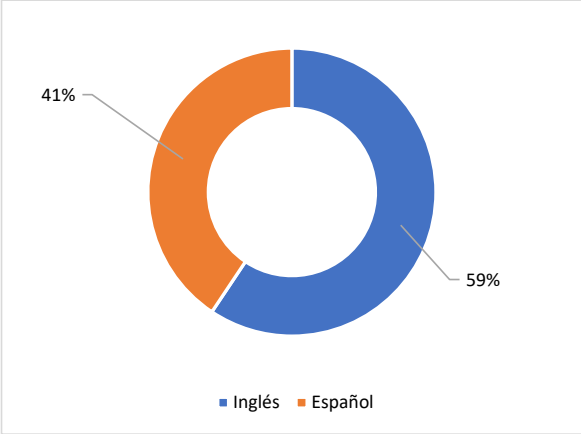

Figure. 3 Articles included in the systematic review are categorized as a result of the language publication

Figure 4 shows that the highest number of keywords with respect to articles included was Academic performance, with an equivalent of 15, followed by Higher education with 14 studies, while the lowest value (1) was the keyword corresponding to STEM.

Figure. 4 Articles included in the systematic review are categorized according to keywords

This present figure shows 5 journals with a maximum frequency of 2 journals: Technology, Science and Education, Computer Applications in Engineering Education, International Journal of Emerging Technologies in Learning, and Ingeniare. Chilean Engineering Journal and Journal of Technology and Science Education, as can be seen in Fig. 5.

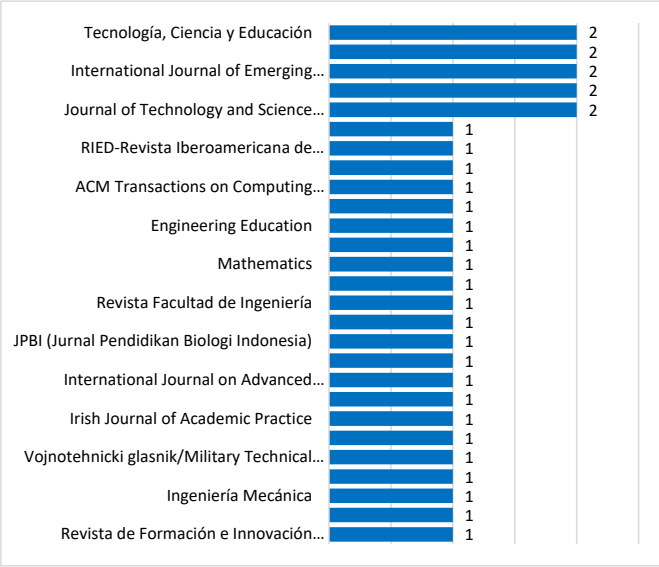

Figure. 5 Articles included in the systematic review are classified according to Scientific Journals

Figure 6 shows the total number of databases used, with the largest number being Scopus with a total of 17 studies, while the least used was Dialnet with a total of 1 in the choice of articles based on the systematic review.

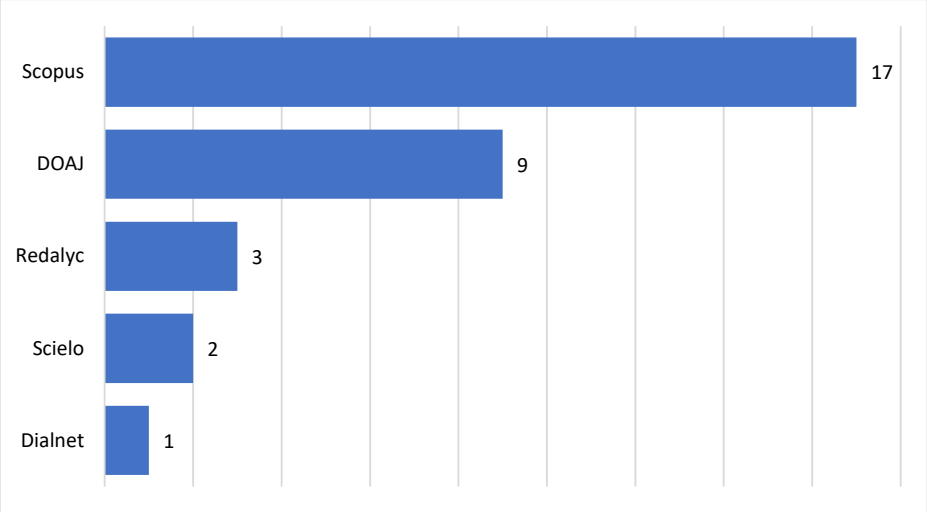

Figure .6 Databases used for the development of the articles based on the systematic review

The following figure shows certain affiliations that have been most used according to the articles included, with OmniaScience Barcelona and Universidad de Tarapacá standing out at the top with a total of 2 studies, while the others have only one publication.

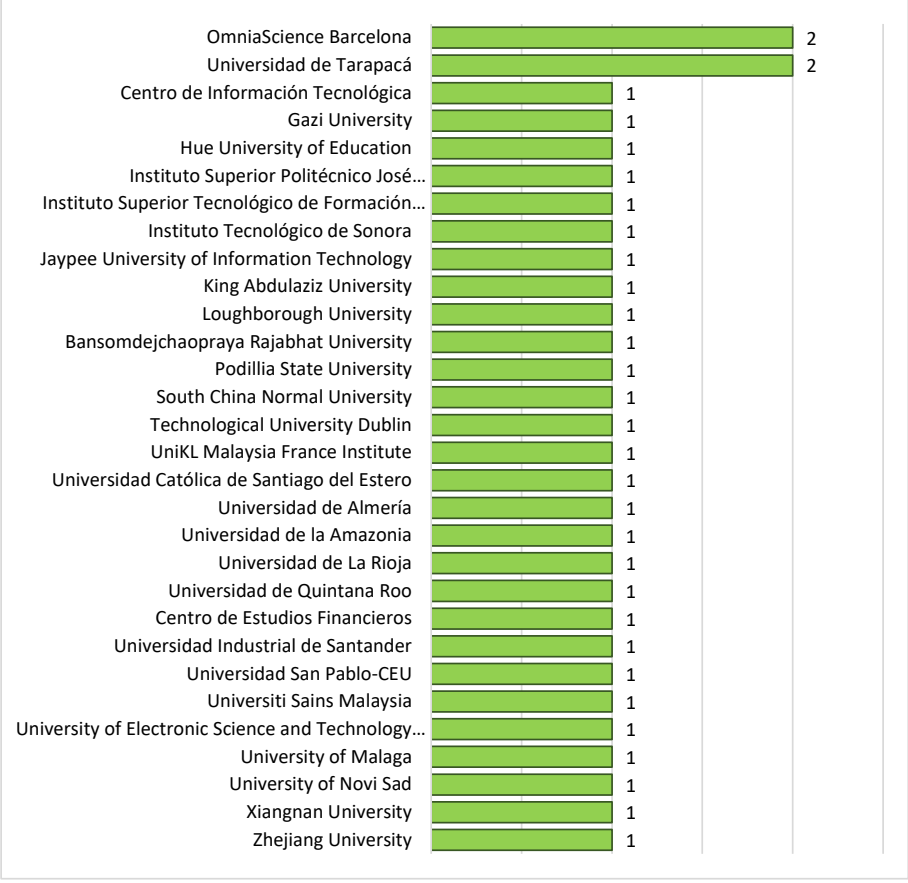

Figure. 7 Affiliations of the main author of each of the articles included in the systematic review

3.2. Content results

Of the selected articles it was made an inclusion, which were selected for the development of the present article, 8 of them used the LMS (Learning Management System) to implement and develop a process program for specific learning, by the way, there is the participation of the mobile tool (4), for self-directed and engaged student learning with the help of mobile devices. This shows that the LMS tool allows for improved learning through virtual teaching. Table 3 presents the application tools used in the selected articles.

Of the articles included for this research work, 8 studies used the LMS (Learning Management System), a software that allows to creation, implementation, and development of a specific learning process. It is a tool directed towards students, a virtual method that improves teaching. It works as an educational learning line. Because of this, it implements an online platform that is responsible for managing, distributing, and controlling non-face-to-face training activities [17, 18, 20, 24, 26, 30, 31 y 38].

The cell phone is an important tool for student learning and analysis. In this regard, this mobile device is used as an educational resource to promote self-direction and engagement [28, 33 y 37].

The MOOC tool (Online Education Online Platform) is an educational software that is based on online learning offered by higher education or private universities [11, 26 y 27].

DT (Decision Tree) is a platform that allows predicting the subject of student dropout and prediction through a target variable with decision rules inferred from the data characteristics [15 y 17].

The ESR (Emotional Speech Recognition) tool is a system that tries to identify and detect human emotions by capturing their perceptual attributes of voice. When implemented in the educational system and analyzed, an improvement in students' motivation and engagement with online educational learning was observed [40 y 42].

The MSE software is a mobile learning self-efficiency tool that allows students to access learning content at any time and anywhere, using mobile devices such as cell phones and tablets, facilitating the content search for their development process [20].

ADDIE (Analyse, Design, Develop, Implement, and Evaluate) is an online educational platform used to create training and performance support tools for student learning. As can be seen, the ADDIE model is based on 5 phases, which are Analysis, Design, Development, Implementation, and Evaluation. In this regard, this model works based on development because it is focused on generating feedback for continuous improvement in students [24].

SCORM (Sharable Content Object Reference Model) is a technology tool that serves as a guide or reference point for developers who use different standards. The most essential thing is that it is compatible with different educational learning management systems, whether for schools or companies [34].

EVA (Entorno Virtual de Aprendizaje) is a virtual education platform confirmed by a set of software tools that make possible didactic interaction. This allows students can access them and develop their skills, promoting the learning process [25].

LSQ (Learning Style Questionnaire) functions as a self-assessment instrument to measure students' learning preferences. This questionnaire consists of different learning styles, in which people can choose some of them and understand them better as they are carried out more frequently with successful strategies and tactics [23].

ANN (Red Neuronal Artificial) is a technological model that is inspired by the functioning of the human brain, in which it remains interconnected with information to learn through it. This tool is also used in the field of learning, which is related to automation and artificial intelligence, to solve problems that are complicated or impossible by human standards. [15].

PLB (Project–Based Learning) is a pedagogical approach that engages students in meaningful projects. Rather than simply memorizing information, these projects allow them to apply what they have learned to real-world situations. Students develop skills such as communication, teamwork, and problem-solving. [14].

ESP (Engineering Applications in Learning) is an application that allows the facility and improvement in students' language learning, in addition, to highlighting the didactic that is the use of the applications [12].

Table 3
Tools of application identified in the systematic review

Tools of application	N° studies
LMS (Learning Management System)	8
Célular	4
MOOC (Plataforma de enseñanza en Línea)	3
DT (Decision Tree)	2
ESR (Emotional Speech Recognition)	2
MSE (Autoeficiencia de aprendizaje móvil)	1
ADDIE (Analyse, Design, Develop, Implement and Evaluate)	1
SCORM (Sharable Content Object Reference Model)	1
EVA (Entorno Virtual de Aprendizaje)	1
LSQ (Learning StyleQuestionnaire)	1
ANN (Artificial Neural Network)	1
PLB (Project –Based Learning)	1
ESP (Aplicaciones de Inginería en el Aprendizajes)	1

On the other hand, the academic effect influences all students attending different institutions. Therefore, the development must be good, and everything related to the learning process. Table IV illustrates the studies conducted to analyze the different tools and improvements that were used in teaching. In this case, from the selected articles, 27 studies were based on the academic approach, which aims to develop students' potential.

In this sense, an improvement in academic performance was observed in 15 studies thanks to the use of M-learning. According to a monitoring program in distance learning systems, this tool promotes positive attitudes and increases student interest by challenging problem-solving and analytical understanding [40]. Likewise, the application of B-learning in a course for university students, which promotes beneficial teaching strategies to engage students and emphasizes that they will have a significant improvement in communication and collaboration skills, resulted in a 46.1% improvement in students who previously took this teaching method [29]. Regarding the study implementing the B-Learning model in a simulation subject, it is reported that the sub-skill of reporting stands out at 41.16%, and the sub-skill of arguing stands out at 22.11% [41]. Based on another argument, the application of a mathematically integrated teaching and learning design a 15.38% improvement in the subject of mathematics in the July 2011 period, and 23.53% in January 2011 and obtained score a B+ or higher score [24]. Additionally, it was evaluated that a total of 90% of students have effectively learned, resulting in a 70% improvement in their performance, achieved through computer-assisted instruction with the implementation of B-Learning [30]. With this in mind, it is important to facilitate, support, improve, and extend the reach of this innovative teaching and learning method, such as the use of M-Learning [33].

On the other hand, we have another point: improvement in teamwork. From researched studies, 3 research studies, provide evidence of this. As for the use of an online teaching platform, it is established that working in a team allows one to acquire knowledge and evaluate the decisions and opinions of others [11]. Furthermore, at the University of Medellín, it was evidenced that the integration of team members' participation results in a greater commitment to their learning process and academic performance [38].

In this sense, 6 studies showed an improvement in students' cognitive skills. With the course of blended learning technological processes, it was possible to provide teachers with the opportunity to insist on the fundamental aspects of the subject [39]. The introduction of M-Learning made it possible to promote learning with the incorporation of new methodologies in

traditional teaching and to innovate new ways of approaching traditional classes and a good tool to enhance the students' autonomous work and provide a summative character in their learning [37].

Consequently, 3 studies presented self-efficacy and student satisfaction, the use of M-learning also influences motivation, interest in acquiring new knowledge, retention, and understanding of information for learning development [28]. On the other, with learning scenarios in E-Learning and B-Learning environments, it was possible to achieve greater proximity among all members participating in it, which is beneficial [31]

Finally, we have 11 correlation studies. Among them, we have 4 studies that focus on the relationship between M-learning and mobile learning. They are oriented on the idea that learning can take place anywhere and at any time. That is why, by executing the proposal of a management system with knowledge of online course design, an improvement in the quality of teaching is visualized [26]. Distance education as a function of the development of E-Learning had access to an improvement in the evaluation of students during live classes compared to the traditional offline [42]. After the pandemic, there was a greater acceptance of online learning, as it increased the use of educational applications for the improvement of students' academic performance [20]. It is even an advantage to adapt to the use of tools and reinforce students' perception of the usefulness of this method in terms of learning [21].

In that sense, 3 studies are based on the relationship between B-learning and simulation teaching. The combination of these two methods allowed the improvement of understanding in the student when approaching learning materials, through software that analyzes correlations in a study [23]. Thus, by predicting academic procrastination, the process of identifying students who have learning difficulties was automated [18], and with the design of massive and open online courses, flexibility, comfort, and a familiar environment were increased when entering their virtual classroom [27].

Finally, 4 studies were obtained on the relationship between E-Learning and distance learning. This learning seeks to bring education closer to the student with the online education method so that they have access to teaching tools wherever they are. The progress in adaptation is important since their learning is open and flexible [31]. Due to this, it was also possible to record an improvement in higher education with respect to cooperative learning, producing greater academic success of students with respect to the traditional curriculum [19]. A study conducted with the support of virtual environments evidences a percentage improvement of 60% to 70% in final exam grades [25]. Finally, the implementation of online teaching increased the collaborative innovation capacity to 0.683 and also a significant existing correlation of around 0.01[11]. Encapsulating all of the above, this study method positively explores students' abilities by demonstrating them in their academic performance.

Table 4
Effects of virtual learning according to articles that have been considered in the systematic review.

Effects	N° of studies
Impact on the teaching-learning process	27
Improvement in regulated academic performance	15
Improvement in teamwork	3
Improvement in cognitive skills	6
Self-efficacy and student satisfaction	3
Relationship between M-learning and mobile learning	4
Relationship between B-learning and simulation learning	3
Relationship between E-Learning and distance learning	4

4. Conclusions

The systematic review of Virtual Education through E, B, and M learning from 2008-2022 demonstrates how it has favored online education in the academic performance of students through easy, accessible, and simple learning. Implementing a strategy like virtual education to enhance an individual's academic efficiency allows for self-efficacy and satisfaction when using it, creating a more dynamic and adaptable environment. According to the articles studied, it is concluded that 32 higher education institutions, based on the selected articles, used virtual teaching to achieve an improvement in cognitive skills, thereby enhancing academic efficiency in students.

Likewise, it is concluded that in higher education institutions of the articles, 90% of the students have learned more effectively by applying the virtual education tool for mobile learning. Additionally, a 70% improvement in academic performance was demonstrated, allowing an increase in teamwork and student self-efficacy.

This article provides a brief introduction to certain research variables, providing valuable support to students in the realm of virtual learning. Therefore, it is important to search more about the subject to enhance the results that have been obtained during the process of this article.

References

[1] Escamilla, José. “Avances en la enseñanza a distancia de la ingeniería.” Revista de Ingeniería 39.2 (2013):67-72.

[2] Padilla, Lucía. “Modelo didáctico basado en hábitos de estudios y rendimiento académico en estudiantes de ingeniería industrial de una universidad privada trujillana, 2015.” UCV-SCIENTIA 9.1 (2017):79-88.

[3] O'brien, Terrance, Butler, Susan, and Bernold, Leonhard. “Group Embedded Figures Test and Academic Achievement in Engineering Education.” The International journal of engineering education 17.1 (2001):89-92.

[4] Esteban, Francisco, Giralt, Carmen, and García, Antonio. “Las nuevas tecnologías y la educación en el ámbito del patrimonio cultural. «Madrid Industrial, Itinerarios». Un ejemplo de m-learning aplicado al patrimonio industrial.” Tecnología, Ciencia y Educación 2 (2015):51-82.

[5] Galkina, A I, Grishan, I A, Kleynosova, N P, Orehvo, D O, and Khrunichev, RV. “Development of e-learning resources for distance learning in the field of radio engineering.” Journal of Physics: Conference Series 2373.2 (2022):1-7.

[6] Cadavieco, Javier, and Sevillano, M.ª. “Beneficios del m-learning en la Educación Superior.” Educatio Siglo XXI 31.2 (2013):211-234.

[7] Linares-Espinós, E., Hernández, V., Domínguez-Escrig, J., Fernández-Pello, S., Hevia, V., Alcalde, J., Padilla-Fernández, B., and Ribal, M. “Metodología de una revisión sistemática.” Actas Urológicas Españolas 42.8 (2018):499-506.

[8] Hutton, Brian, Catalá, Ferrán, and Moher, David. “La extensión de la declaración PRISMA para revisiones sistemáticas que incorporan metaanálisis en red: PRISMA -NMA.” Medicina Clínica 147.6 (2016):262-266.

[9] Urrútia, Gerard, and Bonfill, Xavier. “Declaración PRISMA: una propuesta para mejorar la publicación de revisiones sistemáticas y metaanálisis.” Medicina Clínica 135.11 (2010):507-511.

[10] Page, Matthew, [...], Moher, David. “Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas.” Revista Española de Cardiología 74.9 (2021):790-799.

[11] Cao, Yuewang. “Learning Quality Evaluation of Course Implementation Supported by Online Teaching Platform.” Wireless Communications and Mobile Computing (2022):1-6.

[12] Chaikovska, Olha, Zavadska, Iryna, Ikonnikova, Maryna, and Kozina, Tetiana. “Career-focused esp learning through mechanical engineering android app and fe prep flashcards.” Engineering for Rural Development 21 (2022):514-519.

[13] Durán, Elena, Costaguta, Rosanna, and Gola, Mariela. “El modelo b-learning implementado en la asignatura simulación.” RIED-Revista Iberoamericana de Educación a Distancia 14.2 (2011):149-166.
[14] Arce, María, Míguez-Tabarés, José, Granada, Enrique, Míguez, Carla, and Cacabelos, Antón. “Project-based learning: application to a research master subject of thermal engineering.” Journal of Technology and Science Education 3.3 (2013):132-138.
[15] Tan, Mingjie, and Shao, Peiji. “Prediction of student dropout in E-learning program through the use of machine learning method.” International Journal of Emerging Technologies in Learning 10.1 (2015):11-17.
[16] Deng, Haiyan, and Li, Chunyan. “A Hadoop-Based Online Teaching Model of "VisibleBody".” International Journal of Emerging Technologies in Learning 16.11 (2021):46-58.
[17] Saleem, Farrukh, Ullah, Zahid, Fakieh, Bahjat, and Kateb, Faris. “Intelligent decision support system for predicting student’s e-learning performance using ensemble machine learning.” Mathematics 9.17 (2021):1-22.
[18] Akram, Aftab, Fu, Chengzhou, Li, Yuyao, Javed, Muhammad, Lin, Ronghua, Jiang, Yuncheng, and Tang, Yong. “Predicting Students' Academic Procrastination in Blended Learning Course Using Homework Submission Data.” IEEE Access 7 (2019):102487-102498.
[19] Callejón-Ferre, Ángel, López-Martínez, José, and Carreño-Ortega, Ángel. “Adaptación y desarrollo de la asignatura Motores y máquinas de la titulación de Ingeniero Técnico Agrícola en Industrias Agrarias y alimentarias ante el Espacio Europeo de Educación Superior.” Revista de Formación e Innovación Educativa Universitaria (REFIEDU) 3.3 (2010):141-151.
[20] Kumar, Jeya, Osman, Sharifah, Sanmugam, Mageswaran, and Rasappan, Rasammal. “Mobile Learning Acceptance Post Pandemic: A Behavioural Shift among Engineering Undergraduates.” Sustainability (Switzerland) 14.6 (2022):1-13.
[21] Domínguez, César, Jaime, Arturo, Heras, Jónathan, and García-Izquierdo, Francisco. “The effects of adding non-compulsory exercises to an online learning tool on student performance and code copying.” ACM Transactions on Computing Education 19(3), (2019):363.
[22] Jiao, Pengcheng, Ouyang, Fan, Zhang, Qianyun, and Alavi, Amir. “Artificial intelligence-enabled prediction model of student academic performance in online engineering education.” Artificial Intelligence Review 55.8 (2022):6321-6344.
[23] Molina-Cabello, Miguel, Thurnhofer-Hemsi, Karl, Molina-Cabello, David, and Palomo, Esteban. “Are learning styles useful? A new software to analyze correlations with grades and a case study in engineering.” Computer Applications in Engineering Education 31.3 (2022):537-551.
[24] Bakri, Norhayati, Salwani, Tuan, and Mohd, Zalhan. “Designing an Integrated Teaching and Learning of Mathematics and Image Processing in Engineering Technology.” International Journal on Advanced Science, Engineering and Information Technology 6.4 (2016):548-552.
[25] Demian, Peter, and Morrice, James. “The use of virtual learning environments and their impact on academic performance.” Engineering Education, 7.1 (2012):11-19.
[26] Sandoval, Cristian. “Propuesta para implementar un sistema de gestión del conocimiento que apoye el diseño de un curso online.” Ingeniare. Revista chilena de ingeniería 21.3 (2013):457-471.
[27] Pertuz, S, and Torres, Jorge. “Lineamientos para el diseño de Cursos Online Masivos y Abiertos (MOOC) en Ingeniería Electrónica.” Entre Ciencia e Ingeniería 11.21 (2017):42-49.
[28] Claros-Perdomo, Danna, Millán-Rojas, Edwin, & Gallego-Torres, Adriana. “Uso de la realidad aumentada, gamificación y m-learning.” Revista Facultad de Ingeniería 29.54 (2020):12264-12281.
[29] Sotelo-Castillo, Mirsha, Barrera-Hernández, Laura, Echeverria-Castro, Sonia, and Ramos-Estrada, Dora. “Aprendizaje percibido de estudiantes universitarios en cursos en modalidad presencial y mixta: un estudio comparativo / Perceived learning of university students in face-to-face and b-learning courses: a comparative study.” Revista Latinoamericana de Tecnología Educativa 21.1 (2022):115-127.

[30] Dung, Nguyen, and Fatmawati, Diani. “General informatics teaching with B-Learning teaching model.” JPBI (Jurnal Pendidikan Biologi Indonesia) 4.1 (2018):85-94.
[31] Suárez, Julio, Jiménez, Javier, and Bonilla, Josué. “Uso de escenarios de aprendizaje en entornos E-Learning y B-Learning como alternativa de estudio en la educación a distancia.” Revista de Investigación, Formación y Desarrollo 5.2 (2017):1-9.
[32] Martín-Gómez, Sonia, and Masa-Lorenzo, Cristina. “Aprendizaje m-learning en la materia Dirección de la Producción mediante flipped classroom con entornos colaborativos virtuales y su evaluación con rúbricas.” Tecnología, Ciencia y Educación 8 (2017):93-107.
[33] O'Donnell, Alan. “Using M-learning as a Means to Promote Self-direction and Engagement in Apprenticeship Theoretical Lessons.” Irish Journal of Academic Practice 3.1 (2014):1-30.
[34] Fuente, Mariana, Morales, Leonardo, and Montoya, María. “M-learning y desarrollo de habilidades digitales en educación superior a distancia.” Ensayos Pedagógicos 13.2 (2018):97-118.
[35] Yildiz, Gizem, Yildirim, Abdurrahman, Akça, Bedreddin, Kök, Ayşe, Özer, Açelya, and Karataş, Serçin. “Research Trends in Mobile Learning.” International Review of Research in Open and Distributed Learning 21.3 (2020):175-196.
[36] Al Masarweh, Mohammed, and Afandi, Waleed. “Investigating Factors M-Learning Acceptance and Use for Distance Learning Students in Higher Education.” International Journal of Cognitive Research in Science, Engineering and Education 10.3 (2022):117-128.
[37] Casanovas, Antonio. “El reto de los dispositivos móviles en las aulas universitarias: una respuesta actual al trabajo autónomo y a la evaluación virtual.” Tecnología, Ciencia y Educación 19 (2021):7-52.
[38] Gómez-Álvarez, María, Echeverri, Jaime, and González-Palacio, Liliana. “Estrategia de evaluación basada en juegos: Caso Ingeniería de Sistemas Universidad de Medellín.” Ingeniare. Revista Chilena de Ingeniería 25.4 (2017):633-642.
[39] Domínguez, M, Rey, G, Toll, A, and Delgado, T. “Modalidad de curso semipresencial. Aplicación en la asignatura Procesos Tecnológicos.” Ingeniería Mecánica 11.3 (2008):47-52.
[40] Miljković, Boža, Petojević, Aleksandar, and Žižović, Mališa. “Monitoring the effect of motivation on mastering knowledge and skills in distance learning systems.” Vojnotehnicki glasnik/Military Technical Courier 64.4 (2016):1009-1032.
[41] Durán, Elena, and Costaguta, Rosanna. “Experiencia de Enseñanza Adaptada al Estilo de Aprendizaje de los Estudiantes en un Curso de Simulación.” Formación Universitaria 1.1 (2008):19-28.
[42] Bhardwaj, Prakhar, Gupta, P., Panwar, Harsh, Siddiqui, Mohammad, Morales-Menendez, Ruben, and Bhaik, Anubha. “Application of Deep Learning on Student Engagement in e-learning environments.” Computers & electrical engineering: an international journal 93 (2021):1-11.