Sinergias Educativas

Article

Curricula in higher education and educational innovations mediated by ICT: The case of computer pedagogy courses in Ecuador.

Mallas de estudio en la educación superior e innovaciones educativas mediadas por TIC: Caso de carreras de pedagogía informática en el Ecuador

Luis Ernesto Benavides-Sellan*
Christian Antonio Pavón Brito*
Mariela Alexandra Tapia León*
Jorge Wilson Flores Rodríguez*

Abstract

In the 21st century, continuous innovations in the field of science and technology, especially those related to ICTs, have impacted all areas of human activity. Education, being a holistic process, cannot be separated from this reality. Consequently, these innovations must be considered in the curriculum of computer pedagogical careers. The objective of this study is to analyze the curricula of Ecuadorian universities that offer computer pedagogy courses, through a mixed, documentary and descriptive study, comparing them with innovations in educational ICT. The reviewed grids correspond to the 2023-2024 academic period of seven Ecuadorian universities. The results showed progress in the incorporation of ICT innovations. However, there are topics such as artificial intelligence, robotics,

Master's Degree in Educational Informatics, Universidad de Guayaquil, Luis.benavidess@ug.edu.ec
https://orcid.org/0000-0002-2171-1157

Master's Degree in Physics Teaching, Universidad de Guayaquil, christian.pavonb@ug.edu.ec
https://orcid.org/0000-0002-8913-1546

Master in Management of Information and Communication Technologies, Universidad de Guayaquil, mariela.tapial@ug.edu.ec
https://orcid.org/0000-0002-2609-5955

Master's Degree in Higher Education, Universidad de Guayaquil, wilson.floresr@ug.edu.ec,
https://orcid.org/0000-0002-7436-7441

Sinergias educativas
April - June Vol. 9 - 2 - 2024
http://sinergiaseducativas.mx/index.php/revista/
eISSN: 2661-6661
revistasinergias@soyuo.mx
Page 18-33
Received: January 09 , 2024
Approved: March 22 , 2024

mobile development and 3D printing, among others, that still need to be addressed in a more frontal way within the academic curricula.

Keywords: Academic programs, disruptive technologies, TAC, educational curriculum, academic profile.

Resumen

En el siglo XXI, las continuas innovaciones en el campo de la ciencia y la tecnología, en especial, las relacionadas a las TIC han impactado todos los ámbitos de la actividad humana. La educación al ser un proceso holístico no puede apartarse de esta realidad. Por consiguiente, en las mallas de las carreras pedagógicas informáticas deben considerarse estas innovaciones. El objetivo del estudio es analizar las mallas de las universidades ecuatorianas que imparten la carrera de pedagogía informática, a través de un estudio mixto, documental y descriptivo cotejándolas con las innovaciones en TIC educativas. Las mallas revisadas corresponden al período académico 2023-2024 de siete universidades ecuatorianas. Los resultados evidenciaron avances en la incorporación de innovaciones TIC. No obstante, hay temáticas como la inteligencia artificial, robótica, desarrollo para móviles e impresión 3D entre otras, que aún deben ser abordados de manera más frontal dentro de las mallas académicas.

Palabras clave: Programas académicos, tecnologías disruptivas, TAC, currículo educativo, perfil académico.

Introduction

The last decades of the last century were characterized by continuous innovations in the scientific and technological fields, all supported by ICT. These innovations have affected areas such as industries (Eyzaguirre Silva, 2023; Mamani and Sucari, 2022), employability, and the use of ICTs.employability (Britto et al., 2023; Paquet Targhetta, 2023), health (Britto et al., 2023; Paquet Targhetta, 2023)health (Shao et al., 2022)human relations (Marcos Manjón, 2022) (Marcos Manjón, 2022) among others. In light of the above, it was inevitable that the emergence of new technologies would have a direct impact on educational programs (Monroy-González, 2022). (Monroy-González, 2022).. This incidence is given considering that the essential purpose of education aims at the integral formation of the human being, which implies preparing them for a society in continuous change (Bauman, 2015).

Initial, primary and secondary education are of enormous importance in the educational process of human beings. However, it is higher education that has on its shoulders the fundamental task of delivering new professionals to society (Barreno Salinas et al., 2018).. Therefore, the curricula proposed in the different careers must be characterized by constant innovation and adaptation to the requirements of an increasingly digitized society (Eliseeva et al., 2019).. Programs of study in higher education are operationalized through the academic grids of the different careers.

The curriculum in higher education is made up of a series of elements. Among these are the planning, the proposed objectives, the resources and the methodology to be used. It also implies the guidelines that allow the articulation and organization of the aforementioned elements. The purpose of the curriculum is to underpin the objectives proposed in the different careers. (Pragholapati, 2020) The definition of curriculum has been the subject of discussion; in this study it will be approached from the point of view of considering it as the programmatic content of a career. From this approach, a curriculum involves the description of both compulsory and elective subjects, and also includes the sequencing of the subjects (Fraser and Bosanquet, Fraser and Bosanquet, 2020). (Fraser and Bosanquet, 2006).

The importance of curricula is such that it is considered a fundamental element for the achievement of the objectives and exit profiles of higher education programs. The curricula have a direct impact on the qualitative and quantitative aspects that are proposed through the formative objectives of careers (Mirzaie et al., 2019).. The curriculum of a career cannot be defined only with the simplistic vision of considering it as a set of study plans corresponding to different subjects. It must be able to specify the fundamental knowledge, essential skills and attitudes including ethical values and learning that will allow the intergenerational passage of the knowledge (Amadio et al., 2014).

With regard to academic grids, Acevedo-Gutiérrez, Luz et al, (2019) point out that in the development or updating of the academic grids of university careers, a detailed research should be carried out beforehand. Such research should include a review of the curricula of other higher education institutions (HEIs) that offer similar educational programs, both locally and internationally. However, the same authors cited above emphasize the need to consider the contextual reality in which the HEI operates when developing the curricula or adjusting them.

In the specific case of Ecuador, the Higher Education Council (CES) is in charge of approving higher education programs and their academic curricula. Likewise, it is also the body in charge of approving substantive or non-substantive modifications to the academic curricula of existing degree programs. According to its website (Higher Education Council, 2023) has as its essential function:

to plan, regulate and coordinate the Higher Education System, and the relationship between its different actors with the Executive Branch and the Ecuadorian society; in order to guarantee to all citizens a quality Higher Education that contributes to the growth of the country.

With respect to the requirements for creating or modifying the curricula of higher education programs, these are detailed in the Academic Regulations. The regulations in force at the date of submission of this study are contained in resolution RPC-SE-05-No.012-2022, dated May 5, 2022. (Reglamento de Régimen Académico - Ecuador, 2022).

The Academic Regulations in force in Ecuador specify that adjustments to a curriculum can be substantive or non-substantive. The definition of these two types of adjustments is contained in Article 110 of Chapter II, "Curricular Adjustment and Change of Academic Staff" of the aforementioned regulations. According to this article, a substantive adjustment implies changes in "the graduation profile, duration measured in credits or academic periods, as appropriate, the name of the course or program, or the name of the degree program" (Reglamento de Régimen Académico - Reglamento de Régimen Académico). (Reglamento de Régimen Académico - Ecuador, 2022).. Any aspect that is intended to be modified that is not contemplated in the previous articles is considered a non-substantive adjustment.

The incorporation of ICTs in education has meant not only the appearance of new resources, but also studies to establish their use under a pedagogical approach. In this way, educational innovations provide educators with a wide range of possibilities to enrich the teaching-learning process (Ricardo Barreto and Irriarte Diaz Granados, 2017).. Despite the undeniable possibilities of ICTs to contribute to strengthen learning, there are contexts in which their access is still limited by the different educational actors (Camacho et al., 2020).

Educational innovation implies not only the incorporation of technological elements. In the words of Santiago Criollo-C. et al, (2021) educational innovation "proposes the application of new approaches or practices that are beneficial and have an impact on individuals or academic communities" (p. 1). Among the reasons that drive HEIs to opt for educational innovations are the potential improvement of educational services and the diversification of their educational offerings. The adequate use of educational innovations can, in the medium or long term, reduce costs in terms of elements such as stationery, personnel, etc. (Westera, 2004).

Within the professionalizing careers, one of those with a great capacity to contribute significantly to the development of countries is undoubtedly teacher training. In Ecuador, the teacher training process for the high school level aims at the specialization of teachers in specific areas of knowledge. In this context, the study will focus on teacher training careers related to computer-oriented pedagogy.

ICTs currently provide educators with a wide range of options for both hardware devices and applications. Augmented reality (AR) is a technology that has been successfully incorporated into various educational contexts (León Rodriguez and Viña Brito, 2017).. Augmented reality provides experiences through which students can access images or simulations by interacting with codes or objects. Within disruptive technologies, virtual reality (AR) has also gained notable momentum. In reference to this Alvarado et al. , (2019) consider that virtual reality allows the interaction of the senses through visual stimuli, similar to the elements of the real world. The combination of virtual and augmented realities is what is currently known as mixed reality.

The diversity of resources provided by ICT innovations to educators also includes m-learning, 5G networks, applications As a Service (AAS), the Internet of Things (IOT) and artificial intelligence (AI) (Benavides-sellan et al., 2023).. Among the benefits of learning supported by the use of mobile devices, the ease of carrying the devices is highlighted (Chamba Zarango et al., 2019).. Making a historical review of the progress in mobile technology, the fact of going from 2G technologies to the most recent incursion of 5G technologies stands out. The 5G technology is presented with a wide potential of possibilities such as a greater facility for the control of remote devices and higher speeds. (Noboa Salavarría, 2020).

One of the innovations that offers a wide range of uses at the industrial, medical and educational level is also 3D printing. 3D printing brings to the educational process the possibility of translating computer-generated designs into the physical plane. The fact of being able to generate objects in the real world from designs produced by computer technology is being used in medicine, for example for the generation of prostheses. Among the institutions that take advantage of the benefits of 3D printing, the University of Malaya, located in Malaysia, stands out. Through 3D printing students can produce prosthetic models more adaptable to the needs of patients and at lower cost. (Jaramillo Castro, 2019).

One of the innovative technologies that is gaining increasing momentum in business, government and education is the use of cloud computing, also known as cloud computing. Cloud computing consists of the use of applications and services hosted on remote servers, which users access through local computers. Among the potential benefits of this technology is that it breaks the hardware and software limitations of local computers. By using remote equipment, the capacity to use applications and services is no longer subject to the capacity of local equipment.

Likewise, cloud computing saves costs in terms of licensing, since the user in many cases only has to pay for the applications and spaces he/she uses. Within educational institutions, cloud computing acquired relevance due to the need to virtualize educational processes in the face of the COVID-19 pandemic and the consequent mobility restrictions (Pajuelo Carrasco and Huamanchahua De La Cruz, 20). (Pajuelo Carrasco and Huamanchahua De La Cruz, 2022).. Cloud-computing is further complemented by As a Service technology, which allows managing payments for the use of the different applications and services available on cloud servers (Delgado, 2017).

Although virtual learning objects (VLOs) have been in the educational context for several decades, they are elements that continue to innovate as technologies evolve. According to Chiappe Laverde, A.; Segovia Cifuentes, Y. and Rincón Rodríguez, H. (2007) are conceptualized as modules that integrate several educational resources in digital format, having among their characteristics the adaptability. The cited authors also identify as constituent elements of OVA the academic contents, the different activities to support the learning process and the aspects that contextualize learning.

The development of applications for mobile devices (app) is another of the growing needs that IT professionals must face. The massification of devices that use mobile operating systems and therefore require applications for their operation makes it imperative to know the development of these applications. The successful use of educational mobile applications in different training contexts is also noteworthy. (Vera Zapata and Cárdenas Zea, 2022).. Therefore, it is necessary to consider these competencies in the training programs of computer teachers.

Culminating with the review of some of the ICT-mediated educational innovations, we cannot fail to mention artificial intelligence (AI). Artificial intelligence has made strong inroads in recent years, to the point that a large number of free and paid tools are now available. In addition to the uses of artificial intelligence in robotics, there are applications that can help write documents, generate images, audio and videos. While it is true that AI can be used in an unethical way, it is up to educators to guide their students to an appropriate use that allows the potentiation of learning. (Baidoo-Anu and Owusu Ansah, 2023)..

The technologies described in the preceding paragraphs, when used in a pedagogical context, can become a revulsive for the teaching-learning processes. However, technological backwardness or their inadequate use can become limiting factors for the achievement of the proposed educational objectives. (Vera-Rámirez and Benavides-Sellan, 2021).. Therefore, it is the responsibility of the actors that make up higher education institutions to incorporate and continuously inquire about ICT-mediated educational innovations.

The objective of the study is to analyze the curricula of Ecuadorian universities that teach computer pedagogy, through a documentary study comparing them with innovations in educational ICT.

Materials and methods

The study had a mixed or quali-quantitative design, and descriptive and documentary research was applied. It was based on the review of the curricula of the curricula of the careers of Pedagogy of Experimental Sciences of Computer Science of seven Ecuadorian IES.

The study also reviewed the academic regulations issued by Ecuador's higher education agencies (Reglamento de Régimen Académico - Ecuador, 2022). (Reglamento de Régimen Académico

- Ecuador, 2022).. As of the date of the study, seven HEIs were found that offer the educational career of Pedagogy of Experimental Sciences of Informatics. It is necessary to point out that the pedagogical careers of Experimental Sciences of Informatics initially had another denomination, passing in a period of approximately 5 years to adopt the current name. The previous name mainly emphasized their relationship as educational informatics careers.

The change of modality in the academic periods is another of the variations in the historical context of some of the careers of Pedagogy of Experimental Sciences of Computer Science. This change consisted in the change from annual study periods to the semester modality.

For the process of analyzing the academic grids, a search was carried out on the institutional websites of the HEIs where the course is currently taught. These HEIs are: University of Guayaquil, State University of Bolivar, National University of Chimborazo, Central University of Ecuador, Technical University of Babahoyo, Technical University of Machala and the National University of Loja. In order to compare the academic grids, a Microsoft Excel spreadsheet was used, where worksheets corresponding to each of the training cycles were prepared to place the subjects.

When analyzing the curricula, there are coincidences in certain subjects such as mathematics, research, didactics, pedagogy, professional practices and community outreach. These coincidences are mostly in the subjects generally referred to as common core, that is, those that emphasize research, didactic and pedagogical skills of teachers. It is also observed that there is no homogenization between the subjects that integrate professional praxis, the integration of contexts, knowledge and cultures, and those related to the field of research.

For the analysis of the grids, they were categorized into the four fields that were found to be the most recurrent in the design of the grids. These fields are: theoretical formation, epistemology of research, integration of contexts, knowledge and cultures, as well as communication and language. The limitation in this aspect was due to the fact that not all the grids provided information regarding the categorization of their subjects. Because of this, we proceeded to analyze the subjects in order to place them in a specific field. For this purpose, the expertise of the researchers was used as a reference

for those grids where the fields to which each subject belongs were specified.

Once the procedure described in the previous paragraph was completed, tables were prepared in which each subject was categorized in each of the specific fields. Likewise, a table of key words was created in which some of the main ICT-mediated educational innovations were listed and a search was made for coincidences with respect to the names of the subjects. In order to optimize the results, text string wildcards were used. This is due to the variety in the spelling of the names of certain subjects; for example, the term "Databases" in some grids appears as "Database". A similar situation occurs with the use of "mathematics" and "mathematics".

Results

As explained in the section on materials and methods, one of the first research actions was the preparation of tables containing the list of subjects taught for each academic cycle. Only the State University of Guayaquil and the Technical University of Machala have 9 academic cycles in their study programs, while the other programs have only 8 academic cycles. Through the tables and the information obtained from the grids, the subjects were categorized in the five fields that contain the different subjects.

In the case of the HEIs whose curricula did not specify the distribution of subjects by field, they were assigned as the first criterion based on the expertise of the researchers. They were also classified by referencing them according to the distribution of the grids of the HEIs where the field of study was specified. The HEIs where the distribution of subjects by fields was not specified in their grids were: Universidad Central del Ecuador (UCE), Universidad Estatal de Bolivar (UEB), Universidad Técnica de Machala (UTMACH). In the case of the National University of Loja (UNL), the previous curriculum of the course prior to the last redesign was used as an additional reference for the categorization of subjects. The HEIs where the distribution by subject fields in their curricula was obtained directly were: Universidad de Guayaquil (UG), Universidad Nacional de Chimborazo (UNACH) and Universidad Técnica de Babahoyo (UTB).

The distribution of the subjects by fields and the percentage weight of each of them can be seen in Table 1. As can be seen, the highest average percentage weight (47.80%) corresponds to the subjects corresponding to professional praxis, followed by those belonging to the theoretical foundations (25.15%). The lowest percentage weight in the distribution by fields of the analyzed grids corresponds to communication and language (4.54%).

Table 1. *Mean percentage distribution of subjects of the computer pedagogy curricula according to the training fields and study cycles.*

CICLOS FORMATIVOS / CAMPOS	FORMACIÓN TEÓRICA	PRAXIS PROFESIONAL	EPISTEMOLOGÍA DE LA INVESTIGACIÓN	COMUNICACIÓN Y LENGUAJE	INTEGRACIÓN CONTEXTO SABERES Y CULTURA
Primero	46%	28%	7%	14%	5%
Segundo	40%	35%	12%	7%	5%
Tercero	28%	48%	13%	5%	5%
Cuarto	23%	50%	14%	2%	11%
Quinto	24%	59%	12%	2%	2%
Sexto	18%	57%	14%	0%	11%
Septimo	12%	56%	20%	7%	5%
Octavo	16%	51%	19%	2%	11%
Noveno*	18%	47%	27%	0%	8%
MEDIA GENERAL	25,15%	47,80%	15,48%	4,54%	7,03%

Note: *Only the universities of Guayaquil and Técnica de Machala offer the ninth cycle.

Among the results of the present study, the comparison between ICT-mediated educational innovations and the contents of the curricula stands out. This information can be seen in Table 2.

Table 2. *Results of the search for coincidences between subject names and ICT-mediated educational innovations in the analyzed grids.*

IES / PALABRAS CLAVE	UG	UCE	UCH	UL	UEB	UTB	UTM	# IES DONDE SE ENCONTRO COINCIDENCIA	% SOBRE TOTAL IES
BASE* DE DATOS	SI	SI	NO	NO	SI	NO	SI	4	57,14%
ORIENTAD* A OBJETOS	SI	NO	NO	NO	SI	SI	NO	3	42,86%
MATEM*TICA*	SI	SI	SI	SI	SI	NO	SI	6	85,71%
ROB*TICA INTELIGENCIA	NO	SI	SI	SI	SI	NO	NO	4	57,14%
ARTIFICIAL REALIDAD	NO	NO	NO	NO	NO	NO	NO	0	0,00%
AUMENTADA	NO	NO	NO	SI	NO	NO	NO	1	14,29%
REALIDAD VIRTUAL	SI	NO	NO	NO	SI	NO	SI	3	42,86%
IMPRESI*N 3D	NO	NO	NO	NO	NO	NO	NO	0	0,00%
INMERSIV*	NO	NO	NO	NO	NO	NO	NO	0	0,00%
APP	NO	SI	NO	NO	NO	NO	NO	1	14,29%
PROGRAMACI*N	SI	SI	SI	SI	SI	SI	SI	7	100,00%
WEB	NO	NO	SI	SI	SI	SI	SI	5	71,43%
M*VILES	NO	NO	NO	NO	NO	NO	NO	0	0,00%
3D	SI	NO	NO	NO	NO	NO	NO	1	14,29%
DISEÑO GR*FICO	SI	SI	NO	NO	SI	SI	NO	4	57,14%
ANIMACI*N REALIDAD	SI	NO	NO	NO	NO	NO	NO	1	14,29%
INMERSIVA PENSAMIENTO	NO	NO	NO	NO	NO	NO	NO	0	0,00%
COMPUTACIONAL	NO	SI	SI	SI	NO	NO	SI	4	57,14%
ALGORITMO*	SI	NO	NO	SI	NO	NO	NO	2	28,57%
AS A SERVICE	NO	NO	NO	NO	NO	NO	NO	0	0,00%
CLOUD	NO	NO	NO	NO	NO	NO	NO	0	0,00%
NUBE	NO	NO	NO	NO	NO	NO	NO	0	0,00%
OVA	NO	NO	NO	NO	NO	NO	NO	0	0,00%
OBJETO* VIRTUAL DE APRENDIZAJE	NO	NO	NO	NO	NO	NO	NO	0	0,00%

Note: The * character is a wildcard that replaces one or more text characters, which makes search results in text strings more flexible.

The comparison was made by searching for matches between the names of the subjects and those of the ICT-mediated educational innovations. In order to improve the results, wildcards (*) were used for flexible search in text strings.

As shown in Table 2, there are ICT-mediated educational innovations with a high presence in the names of the subjects. Given the technical pedagogical nature of the course, the subject of

computer programming is present in all the curricula of the different HEIs (100%). The second subject present in most of the curricula is mathematics (85.71%). Although it is true that mathematics is one of the oldest sciences in human history, its importance makes it necessary to include it permanently in any educational program. The development of web applications also has a high degree of integration (71.43%). Other innovations such as databases, robotics, graphic design and computational thinking have an average percentage of 57.14% of presence in the names of the subjects. Other innovations such as virtual reality register a coincidence slightly above 40%.

Among the innovations with lower coincidence with respect to subject names (<15%), mobile application development, augmented reality, animation and 3D technologies stand out. No coincidences in subject names were found regarding 3D printing, As a Service, development for the cloud or cloud-computing, immersive reality and artificial intelligence.

Discussion

The distribution of subjects in the academic curricula of computer pedagogy degree programs reveals a greater weight of those belonging to the field of professional praxis. These subjects are those that provide the essential skills for the operability of the teaching profession. In second place are the subjects corresponding to the field of theoretical training. They are followed in the distribution by those pertaining to the epistemology of research. The least weight is assigned to the subjects belonging to the field of language and communication, as well as to the integration of contexts, knowledge and culture.

The results described above are consistent with the holistic-practical nature of the pedagogical career in experimental computer science. The essential purpose of computer pedagogy careers is to train professionals capable of managing computer technologies in educational and productive contexts. At the same time, graduates must possess pedagogical skills and knowledge of the different methods for the effective application of educational strategies. (Cárdenas Benavides et al., 2023)..

With respect to the coincidences between subject names and ICT-mediated educational innovations, the efforts of HEIs to integrate these innovations into their curricula are noteworthy.

Notwithstanding the above, Latin American universities must face not only limitations in access to technology but also concomitant social and political factors. In the case of the Latin American region, public universities in particular must in many cases accept students with deficiencies in basic training areas such as mathematics and language (Ramirez, 2023). (Ramirez, 2023).

It was established that there are innovations in which no coincidence was found with respect to the name of the subjects (3D printing, As a Service, development for the cloud/cloud, immersive reality and artificial intelligence). In the case of other innovations, low levels of coincidence were found (mobile application development, augmented reality, animation and 3D technologies). It is necessary to emphasize that many of these innovations can be handled through transversal axes within other subjects. Despite this, we consider it important to incorporate elements such as artificial intelligence, mobile applications, robotics, immersive reality and the development of cloud services as subjects. This need responds to the fact that the aforementioned technologies are elements that are increasingly achieving greater penetration in society (López-Gil, 2017; Ocaña-Fernández et al., 2019; Pajuelo Carrasco and Huamanchahua De La Cruz, 2022)..

Of the educational institutions that offer the career of Pedagogy of Experimental Sciences of Informatics in Ecuador, all of them are publicly supported. Therefore, the Ecuadorian state has the responsibility to provide these training centers with material resources and to implement continuous training programs for teachers. The fulfillment of the state's role as a provider, together with the correct management of the directors and the commitment of teachers, will make it possible to reduce the gaps in access to technologies. This in turn will result in graduates with a wide variety of technological and pedagogical competencies for the benefit of Ecuador's youth and children.

References

Acevedo-Gutiérrez, L. E., Cartagena-Rendón, C. M., Palacios-Moya, L., & Gallegos-Ruiz-Conejo, A. L. (2019). Comparative analysis of curricular grids of marketing technology programs. *CEA Journal*, *5*(9), 97-112. https://doi.org/10.22430/24223182.1254.

Alvarado, Y., Jofré, N., Rosas, M. and Guerrero, R. (2019). *Virtual Reality and Augmented Reality applications as support for the*

teaching of Technical Drawing. 65-74.

Amadio, M., Opertti, R. and Tedesco, J. C. (2014). A curriculum for the 21st century: Challenges, tensions and open questions. *Research and foresight in education: working papers*, *9*(41), 1-4. https://unesdoc.unesco.org/ark:/48223/pf0000229458_spa

Barreno Salinas, M., Barreno Salinas, Z. and Olmedo Valencia, A. C. (2018). Higher education and its link with society: essential referents for a change. *Revista Universidad y Sociedad*, *10*, 40-45.

Bauman, Z. (2015). *Modernidad líquida*. Fondo de cultura económica.

Benavides-sellan, L. E., Pavón-Brito, C. A., Vera-Ramírez, N. and Tapia-León, M. A. (2023). Perceptions and research trends in ICT-mediated educational innovation: case doctoral studies in the Latin American context. *Journal of Business and entrepreneurial*, *7*(April), 71-82.

Britto, J., Urraca-Ruiz, A., Ferraz, J. C., Torracca, J. and Schmidt, H. (2023). The impact of digitalization on employment and skills by stages of adoption in Brazil and Argentina. *Revista Brasileira de Inovação*, *22*, e023015.

Cárdenas Benavides, J., Fuentes Seisdedos, L., Valle Oñate, P. and Usca Veloz, R. (2023). Exploring educational frontiers: relevance of informatics pedagogy. *Magazine de las Ciencias: Revista de Investigación e Innovación*, *8*(3), 81-105. https://doi.org/10.33262/rmc.v8i3.2922

Chiappe Laverde, A., Segovia Cifuentes, Y. and Rincón Rodríguez, H. Y. (2007). Toward an instructional design model based on learning objects. *Educational Technology Research and Development*, *55*(6), 671-681. https://doi.org/10.1007/s11423-007-9059-0

Regulations of Academic Regime - Ecuador, CES 1 (2022). http://gaceta.ces.gob.ec/resultados.html?id_documento=251023

Council of Higher Education (2023). *CES - Council of Higher Education*. Mission, Vision and Objectives. https://www.ces.gob.ec/?page_id=44

Criollo-C, S., Moscoso-Zea, O., Guerrero-Arias, A., Jaramillo-

Alcázar, Á. and Luján-Mora, S. (2021). Mobile Learning as the Key to Higher Education Innovation: A Systematic Mapping. *IEEE Access*, *9*, 66462-66476. https://doi.org/10.1109/ACCESS.2021.3076148

Eliseeva, E., Prokhoda, I. A., Karbanovich, O. V, Ivanova, N., Savin, A. and Khramchenkova, A. (2019). Improving information technology training of the future specialists in the higher educational establishments in the conditions of digital economy. *IOP Conference Series: Earth and Environmental Science*, *274*. https://doi.org/10.1088/1755-1315/274/1/012130.

Eyzaguirre Silva, A. C. (2023). *Study of the impact of technological advances on productivity in the construction industry*.

Fraser, S. P. and Bosanquet, A. M. (2006). The curriculum? That's just a unit outline, isn't it? *Studies in Higher Education*, *31*(3), 269-284. https://doi.org/10.1080/03075070600680521

León Rodriguez, G. de la C. and Viña Brito, S. M. (2017). Artificial intelligence in higher education. Opportunities and threats. *INNOVA Research Journal*, *2*(8.1), 412-422. https://doi.org/10.33890/innova.v2.n8.1.2017.399

López-Gil, K. (2017). Relationships between mobile devices, invisible learning and digital competence of university students. *XVIII Virtual Educa International Meeting*, *September*.

Mamani, U. Q. and Sucari, Y. V. S. (2022). CONVERGING TECHNOLOGIES IN INDUSTRY 4.0 (I4. 0). *Waynarroque-Revista de ciencias sociales aplicadas*, *2*(4), 63-74.

Marcos Manjón, C. (2022). *The impact of disruptive technologies on work relationships*.

Mirzaie, M., Mirzaie, M. and Ajam, A. (2019). Evaluation of the Relationship between Curriculum Elements and Medical Students' Disposition Toward Critical Thinking (Case Study: Medical Students). *Journal of Medical Education Development*, *12*, 48-54. https://doi.org/10.29252/edcj.12.35.48.

Monroy-González, L. A. (2022). Industry 4.0 and its impact on education. *Uno Sapiens Boletín Científico de la Escuela Preparatoria No. 1*, *5*(9), 6-10.

Ocaña-Fernández, Y., Valenzuela-Fernández, L. A., & Garro-Aburto, L. L. (2019). Artificial intelligence and its implications in higher education. *Purposes and Representations*, *7*, 536-568. http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S2307-79992019000200021&nrm=iso

Pajuelo Carrasco, C. and Huamanchahua De La Cruz, D. (2022). Cloud Computing in the digital transformation of university education institutions. *Journal of Systems and Informatics Research*, *15*(1), 53-62. https://doi.org/10.15381/risi.v15i1.23085%0Ahttps://revistasinvestigacion.unmsm.edu.pe/index.php/sistem/article/view/23085. https://doi.org/10.15381/risi.v15i1.23085%0Ahttps://revistasinvestigacion.unmsm.edu.pe/index.php/sistem/article/view/23085

Paquet Targhetta, C. (2023). *The Impact of Innovation on Skilled Employment*.

Pragholapati, A. (2020). *DEVELOPMENT OF CURRICULUM OF HIGHER EDUCATION (3 COUNTRIES)*. https://doi.org/10.35542/osf.io/jfzg5

Ramírez, T. (2023). Latin America and overcoming technological backwardness. *Areté, Revista Digital del Doctorado en Educación*, *9*, 7-9.

Shao, M., Fan, J., Huang, Z., & Chen, M. (2022). The impact of information and communication technologies (ICTs) on health outcomes: A mediating effect analysis based on cross-national panel data. *Journal of Environmental and Public Health*, *2022*.

Vera Zapata, M. and Cárdenas Zea, M. P. (2022). Mobile applications and devices as a pedagogical tool for the teaching process. *Cognosis Journal. ISSN 2588-0578*, *7*(3 SE-), 109-126. https://doi.org/10.33936/cognosis.v7i3.5116

Westera, W. (2004). On strategies of educational innovation: Between substitution and transformation. *Higher Education*, *47*, 501-517. https://doi.org/10.1023/B:HIGH.0000020875.72943.A7