European Journal of Educational Research

Digital Andragogical Competences of Ecuadorian Higher Education Teachers during the COVID-19 Pandemic

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Abstract: The changes brought about in higher education by the Coronavirus disease (COVID-19) pandemic require effective action. Teachers must be trained to work on university platforms. The study allows us to analyse the current educational problems, which are found in many countries, not only in Ecuador. The research aimed to determine the virtual andragogical competencies of Ecuadorian university education during the COVID-19 pandemic. A mixed research approach was used. A quantitative analysis was applied first, followed by a qualitative analysis. The sample selection was participatory and non-probabilistic. The sample consisted of 1003 active higher education teachers in Ecuador. A questionnaire of 106 questions divided into four variables was applied. A multiple analysis of variance (MANOVA) was performed. The analyses demonstrated the need to apply four integral competencies. First the teacher must "Know how to be", through continuous ICT training. After the teacher has been trained, he/she must "Know". This process involves mastering educational technology. After updating knowledge, they must "Know how to live together". Develop critical and constructive communication. Then "Know how to do" by applying an effective guiding methodology. Teacher training under the competency-based approach is seen as a viable alternative.

Keywords: *Higher education, technology, teaching competences, virtual education, andragogy.*

Introduction

The changes brought about in higher education by the Coronavirus disease (COVID-19) pandemic require effective action. Teachers must be trained to effectively take on the role of university researchers. Universities are currently in a period of continuous transformation, and for this reason, all universities must update themselves (Scull et al., 2020). Universities must generate and innovate in an accelerated and vertiginous manner. They must respond to the challenges posed by advances in science and technology (Cuesta, 2018). University education is primarily organised to achieve learning. Educational platforms contribute to solving problems in the social environment that affect students (Hurtado, 2018). Learning is strengthened through the experience of its members. There is also the possibility of developing skills that foster students' intellectual growth. When the learner overcomes self-management and self-responsibility, the results are exposed in many environments. These results show up in society, also in the economy and culture.

In this sense, Gispert (2003) states that, teachers must take on the arduous task of guiding students. At present, the COVID-19 pandemic has forced a change in the mode of study. Education has shifted from face-to-face to virtual. Teachers are now pursuing knowledge mastery through virtual platforms. Virtual education demands changes in teaching and learning processes. Virtual competence emerges as new paradigms to meet the challenges of the future (Standish, 2016). The faculty as a member of the university institution lies in efficiency and effectiveness.

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Therefore, the aim of this research was to describe andragogical competences to strengthen Ecuadorian university virtual education. The present study establishes new contributions in virtual university education. This problematic situation is not only found in Ecuador. It is also found in many countries. The study responds to the requirements of the virtual teaching and learning process. Digital competences for university teaching staff are also proposed. Digital competences strengthen scientific and academic productivity at the university. University effectiveness is guided by research faculty (Biesta & S'fstrom, 2018). Establishing a digitally skilled faculty that today's society requires.

Literature Review

Andragogy

Malcolm Sephard Knowles, considered the father of andragogy, was born in 1913 in Montana, USA and died in 1997. For Knowles (1990) the term "andragogy" is an appropriately organising concept of what was known from experience and research about the unique characteristics of adult learners. For Azmi and Noer, (2020); Chacón, (2012), adulthood is between the ages of eighteen and seventy. Thus, three groups are considered according to age. The first group as early adulthood (from 18 to 40 years of age). The second group is called "middle adulthood" (from 40 to 65 years of age). The third group is called "late adulthood" (after 65 years of age) (Loeng & Omwami, 2018; Sánchez, 2005).

Garita, (2008) states that the university is a science of adult education. This science is known as Andragogy. Its etymological origin comes from the Greek andros "human being, older person" and "to lead, to guide". The term "gogia" refers to logic. Andragogy is a science and an art of lifelong learning. It is the education of adults in terms of their intellectual, cultural, ecological and social life. The young adult who arrives at university comes equipped with a range of intellectual and academic experiences. They also come with significant skills, concerns, values, expectations and aspirations. These skills need to be harnessed by teachers. Experience becomes a determining element in the way students engage in learning. Today the main challenge for everyone is to use the virtual experience. Using this digital experience for effective learning (Araya et al., 2012; Marrero, 2004).

The term adult is related to the bodily component (physiological progress). There is also the social and mental (psychological) component. In contrast to the adult, thinking and attitude characterise the child. The educational model applied is characterised by "pedagogy". In etymology, the term andragogy and pedagogy are different. The word "andragogy" has long been a focus of etymological discussion. Therefore, a student over the age of 18 is in the adult stage (International Institute of Andragogy, 1986; Snyman & Berg, 2018). The student body at university should be considered as adults. Because they are adults, andragogy techniques are applied to them (Adam, 2008). To place the theoretical basis in it, there are curricular proposals and coherent methodological strategies (Aguinaga et al., 2018). There are psychological and socio-cultural aspects that characterise adulthood (Bilbao, 2008).

In accordance with the above considerations, andragogy-type education should be considered in university students. This type of praxis is part of university education systems (Cruz, 2002; Pérez, 2009). In this sense, andragogical training operations aim at innovative models. These are new models and conceptions adjusted to reality, totally different from the traditional conception (Aguilar, 2015; Morales & Leguizamón, 2018; Van Griethuijsen et al., 2020).

Educational competences

The term "competence" has acquired, over the last years, a quite relevant importance in education. In higher education, learning is determined by competences. Competences are the necessary qualities that a professional requires for optimal job performance (Van Griethuijsen et al., 2020).

In education, ICT enables teachers to engage their students in new ways of teaching and learning. Attitudes characterize cooperation in the Knowledge Society. Learners need to develop skills on a personal level. Competences must be acquired to be able to function in society. These facets characterize the educational context of higher education. An example of attitudes can be altruism. Altruism is necessary to generate knowledge and to be able to share it with others without expecting anything in return. People create, share and elaborate knowledge through continuous and rapid processes. This process is known as feedback. There is also respect for the work of others, without appropriating it, only building on it (Van Griethuijsen et al., 2020).

For Alonso and Blázquez (2012). today's teacher must have 4 integral competences. The "Knowing" competence (knowledge that a person possesses). The "Knowing how to do" competence (skills and abilities of the individual). The "Knowing how to be" competence (attitudes that guide their behavior and decisions). The competence "Knowing how to live together" (attitudes that the person assumes internally and/or in relation to the environment).

Osbeck et al. (2018), state that teachers should receive conceptual training in relation to ICT. Competences transform, support the learning environment and learning environment. This can help to change beliefs about ICT. Competences help teachers to update and renew themselves in their work. Competences strengthen their own educational content and resources. These competences make the teacher a competitor. They allow them to change their role from that of repeater of experiences to that of generator of knowledge.

Virtual education in universities

Virtual education should focus on three main points, first the communication medium, second the teacher and third the student (Mendoza et al., 2021). The first prioritizes the technological tool and the approach to the teaching-learning process (Loeng & Omwami, 2018). In the second, dominant at the higher level. The teacher is constructed as the only valid referent of knowledge. This knowledge is conceived as transmissible. In other words, it is strongly linked to classical methodological models (Roessger et al., 2020). Finally, the learner-centred and self-training model (Hirsch, 2016).

Today's universities require an integrative model, articulating the three dimensions in search of an open and flexible methodology. This virtual model places the student as the protagonist of learning situations (Hooshyar et al., 2019). The characteristics acquired by this methodological adaptation, virtual education and teaching competences are the focus of analysis of this study.

Methodology

Type of research goal

Therefore, the main objective of the study is to:

- To determine the andragogical competencies of university teaching staff in Ecuadorian virtual education during the COVID-19 pandemic.

Type of research

The type of research was multi-method or mixed method. Mixed-method research is based on the qualitative and quantitative paradigm (Núñez, 2017). The mixed-method study encompasses descriptive and interpretive research. The descriptive study tends to represent unique aspects of the subjects, which were subjected to the researchers' analysis. Interpretive analysis is characteristic of social studies (Universidad Pedagógica Experimental Libertador, 2016). Interpretative studies allow for the explanation and understanding of more complex social facts or phenomena. All of them are based on a theoretical framework, manifestos or interviews. They are in-depth studies of the social fact or cultural phenomenon. Descriptive and interpretative research allowed the collection of relevant aspects. These aspects represent the andragogical qualities of university teaching staff. These realities are perceived in the activities of university platforms (Mendoza et al., 2019a).

Research design

Research design begins with a set of actions. The actions explain how it has been done; they shape the methodological structure. It also measures the circumstances, resources and constraints that make it possible to conduct and develop the study. The study design is defined as the overall research procedure (Balestrini, 2002). This plan is integrated in a coherent and appropriately correct way. It is supported by the data collection techniques to be used, the plan and the objectives to be analysed. A research design provides methodical and precise answers to the stated objective.

The research design was DIAC (nested or simultaneous integrated design of the dominant qualitative model) (Hernández et al., 2014). The DIAC design collects quantitative data through surveys or questionnaires. Basic and simple statistical studies are then applied. The data are quantified according to the variables in the instruments. Then in the qualitative phase, the triangulation method is applied. This method refers to the contrast of various sources of information, use of various methods, theories, interpretation of authors. The triangulation method does not mean that literally three methods have to be used (Samaja, 2018).

Population and sample

According to Arias, (2012) the population is the total set of informants. The sample only determines a subset to which access is available. In the Republic of Ecuador 18 universities have Faculties of Education Sciences. The population consisted of 5109 education teachers according to (Secretary of Education, Higher Science, Technology, and Innovation Ecuadorian, 2021).

The sample selection technique was chosen by the non-statistical method. The non-probability sampling technique was applied for sample selection. The method involved voluntary participation. The researchers established criteria that allowed the selection of participants (Vega et al., 2019). This type of sampling can also be known as self-selected. For reasons of health care and prevention (Pandemic COVID-19). Crowds and face-to-face surveys could not be conducted. The researchers sent an e-mail invitation to the teaching population. Those who accepted were considered the study sample. The sample established criteria for participation. For example: "I am willing to participate voluntarily in the study" (Vega et al., 2019). The sample consisted of 1003 teachers. This sample represented 19.63% of the Ecuadorian university teaching population in the A-2021 cycle.

Data collection techniques and instruments

Data collection techniques are defined as the means of interaction with participants (Hernández et al., 2014). These instruments allowed for the collection of accurate data. The instruments help to meet the objectives of the research.

The digital questionnaire was applied. This instrument is the most common instrument in quantitative studies in times of pandemics (Arshad et al., 2021).

The Likert-type attitude scale was used for the research. This tool involves the selection of statements according to certain norms. These statements gave numerical data measuring the level of approval or percussion (Cecchini et al., 2018). The written record quantifies attitudes, ranking and recording levels of conformity and impact. Its ease of descriptive analysis originates at the level of attitudes and competencies. These scales include a middle ground of left-right balance (Matas, 2018). The options start from "strongly disagree with 1 point" to "strongly agree with 5 points" (Cejas et al., 2019).

For the design of each of the research instruments, 4 study variables were structured as recommended by (Agreda et al., 2016). Variable 1, technology use and literacy (See Appendix 1). Variable 2, educational methodology through ICT (See Appendix 2). Variable 3, university teacher training in ICT (See Appendix 3). Variable 4, attitude towards ICT in higher education (See Appendix 4).

The questionnaires were structured with one hundred and six (106) questions for the 4 variables. Each question has five response items. The first one is "Strongly agree" (5). The second option is "Agree" (4). This is followed by the response option "Undecided" (3), which is the midpoint of the scale. The response option "Disagree" (2). Finally, the response option "Strongly disagree" (1).

Reliability of the instruments

The accuracy of the research instrument is analysed with the reliability (Barraza & Barraza, 2018). To determine the reliability, the "Cronbach's Alpha statistical coefficient" was applied. A pilot test was applied to 10 teachers. Table 1 shows the results obtained through the Statistical Package for Social Sciences Software (SPSS) version 25. The statistical coefficient was on average .901. Results within the range of .700 to .999 indicate good internal stability for the instrument (González & Pazmiño, 2015; Mendoza et al., 2019b).

Table 1. Values obtained for Cronbach's alpha reliability coefficient

Questionnaires	Variation of the elements	Standard deviation	N of elements	α
Variable 1	.890	.590	16	.901
Variable 2	.892	.359	25	.906
Variable 3	.901	.427	23	.874
Variable 4	.913	.586	16	.926
Total				.901

Statistical analysis of the data

As a descriptive statistical study, the random variable is analysed in a normality test. We want to analyse whether the variables have a normal distribution. The study sample was 1003 teachers. The Kolmogorov-Smirnov test was chosen for samples larger than 50. If the p-value is less than 0.05, then the variable is not normally distributed. Therefore, non-parametric tests are applied. If the p-value is greater than 0.05, then the random variable does have a normal distribution. Therefore, parametric tests are applied.

In the quantitative phase, multivariate analysis of variance (MANOVA) was applied. The MANOVA analyses the differences between groups according to multiple dependent variables (Holmes, 2020). MANOVA allows the analysis of two or more variables. These variables can be independent. This technique allows estimating significant differences between the means of several variables, through joint comparison. The significance level of the various contrasts must be $p < 0.05$. If the coefficients have a $p < 0.05$. Then the variables have an effect on the ratings of the presentations on the criteria "digital competences".

Qualitative analysis of the results

After establishing the quantitative analyses, we proceeded to the final qualitative analysis. The results were interpretatively analyzed through the application of data triangulation. Triangulation made it possible to combine theoretical contributions, texts, previous studies, questionnaires, external opinions, interpretation of authors, among others. In this way, the competences sought during the study were formulated (Aguilar & Barroso, 2015).

Triangulation contrasts the variables of the quantitative phase with theories and the authors' interpretation. These analyses are interpretative (qualitative analysis). The research considered this design, as it allows the variables of the

questionnaire to be analysed qualitatively. It makes it easier to analyse the virtual andragogical competences needed by university teachers in Ecuador. The quality of the qualitative analyses was validated by expert judgement. The results were analysed by three experts in Digital Competences and Teaching Competences (an A-level analysis was obtained). The quality of measurement was ordinal. Level A represents an acceptable analysis. Level B represents an analysis that requires adjustments or changes. Level C represents a rejected analysis. The triangulation of information was considered effective by the evaluators.

Results

Statistical analysis

After surveying the participating teachers, the researchers tabulated the data. Statistical data were analyzed, the sum of frequencies, variances, variances, deviations and means were obtained. The 4 study variables were independent. They were all causally related to the digital competences that teachers should possess. First, the test of equality of covariance matrices was applied (See Table 2).

Table 2. Box's test of equality of covariance matrices

Box's Test of Equality of Covariance Matrices	
Box's M	1073.245
F	88.935
df1	12
df2	2497005.835
Sig.	.190

The results show that the data were non-significant. The significance is .190, therefore, the homogeneity of the covariance matrices is met. After applying the test of equality of covariances. The Kolmogórov-Smirnov normality test was applied (see Table 3).

Table 3. Kolmogórov-Smirnovà normality test

	Statistic	df	Sig.
Variable 1 (Use and ICT literacy in higher education)	.984	789	.0752
Variable 2 (Educational methodology through ICT)	.959	752	.0697
Variable 3 (Training of university faculty in ICT)	.992	991	.1803
Variable 4 (Attitude to ICT in higher education)	.903	723	.0609

*. This is a lower bound of the rue significance.
a. Lilliefors Significance Correction

The results showed that the significance values $p > .05$. Therefore, the normality of the data distribution is demonstrated. In addition, the effective application of parametric tests such as MANOVA is tested. The multivariate test was then applied to see if there are significant differences between the group means (See Table 4).

Table 4. Multivariate test of research variables

	Effect	Value	F	Hypothesis df	Error df	Significance
Group	Pillai's Trace	.447	43.680	3.000	2994.000	.048
	Wilks' Lambda	.605	45.898	3.000	2635.460	.047
	Hotelling's Trace	.569	47.131	4.000	2984.000	.039
	Roy's Largest Root	.368	91.825c	5.000	998.000	.042

To check the effect size, the Cohens d test was applied. The Cohen's d test standardises the difference in means. It divides the difference between the two means by one standard deviation (Uttley, 2019). The test is only applied between two variables. For this, variables 1-2, 1-3, 1-4, 2-3, 3-4 were calculated simultaneously. The Cohens d test was applied in SPSS software. Comparison of independent sample means (see table 5).

Table 5. Calculation of the effect size on the variables (Independent samples test)

	N	Mean	Std. Deviation	Mean Difference Cohen's d
Variable 1	1003	4076	1.7379	.813
Variable 2	1003	4075	.0901	
Variable 2	1003	4075	.0901	.877
Variable 3	1003	4074	1.6099	
Variable 1	1003	4076	1.7379	1.194
Variable 3	1003	4074	1.6099	
Variable 1	1003	4076	1.7379	.810
Variable 4	1003	4075	.159	
Variable 4	1003	4075	.159	.874
Variable 3	1003	4074	1.6099	

The values indicated in the Cohen's *d* are greater than .8. A correlation coefficient $.20 \leq d < .50$ is usually considered a small effect size. A correlation coefficient $.50 \leq d < .80$ is considered a medium effect size. A correlation coefficient Si d $\geq$ .80 is of high magnitude. The results in table 4 show that the effect size is high magnitude (Smalheiser et al., 2021).

The data showed that there are significant differences between the variables. In the case of homogeneous variance for 4 variables. The Multivariate Tests in SPSS recommended by (Özlem et al., 2019) were applied. The data were the Pillai's trace statistic the samples are balanced by having a coefficient of $.048 < .050$. Also, the Wilk's Lambda coefficient with a value of $.047 < .050$. The Hotelling's Trace with a value of $.039 < .050$. Roy's Largest Root with a value of $.042 < .050$. Discriminant analysis was then performed. This analysis allowed us to determine the nature of the differences that exist (Lateef et al., 2015). The structure matrix shows the level of importance of each of the response options (See Table 6).

Table 6. Presentation of the structure matrix

Variable	Options				
	1	2	3	4	5
Variable 4 (Attitude to ICT in higher education)	.499	.659	.700	.703	.711
Variable 3 (Training of university faculty in ICT)	.282	.388	.576	.901	.501
Variable 2 (Educational methodology through ICT)	.328	.489	.523	.620	.578
Variable 1 (Use and ICT literacy in higher education)	.598	.682	.702	.862	.697

First, variable 3 with a coefficient of .901, option 4. Expresses, teachers "Agree", that the most important competence is "University teacher training in ICT". In second place, variable 1 with a coefficient of .862, option 4. Expresses, teachers "Agree" on the competency "Use and ICT literacy in higher education". Third, Variable 4, option 3. expressed, teachers "Strongly agree" in developing "Attitude to ICT in higher education". Fourth, Variable 2 option 4. expresses, teachers "Agree" on the competency "Educational methodology through ICT".

Qualitative analysis of results

Integral competence "Knowing how to be" is related to Training of university faculty in ICT

After analyzing the order and importance of the suggested competences. The necessary contents were identified in relation to the selected variables. It was shown that the competence "Training of university faculty in ICT" is the most important. This competence is of an integral type. This variable is related to "Knowing how to be" (Osbeck et al., 2018).

To "Know how to be", teachers must assess the strengths and weaknesses of technological media. This integral competence is assessed through training. Through training, the ethical principles of the use of technologies are respected (Kümmel et al., 2020). Curiosity and motivation for continuous learning must also be present. Improvement in the use of technologies. Lifelong learning competence offers a gradual development scheme. Competences go beyond the basic technological ones. They comprise initial and continuing training (Azmi & Noer, 2020). Initial training familiarizes teachers with the basic recognition and use of ICT. The competences attached to ICT training include:

- Knowledge and handling of the educational platform.

- Knowing how to explore its main tools.

- The identification of digital educational materials.

 In-service training is after initial training. Teachers have a variety of training proposals available to them. These lead them to reflect on the use of ICT in higher education. Use and creatively develop guidance and assessment resources (Loeng & Omwami, 2018).

Based on the opinions of the respondents. The teachers expressed "my educational training was face-to-face". These opinions indicate that teachers do not have practical ICT skills. Their andragogical training was face-to-face. This does not make it easy for teachers to adapt and update their ICT skills. Others said "I have learnt to use the platforms independently". Teacher training in ICT should be analysed from a double perspective (as senders and receivers). Teachers do not have a good command and knowledge of ICT tools. Many are "forced" to learn because their students have the knowledge. After mastering the field of virtual education. Teachers can personalise the contents to reality.

The integral competence: "Knowing", is related to "Use and ICT literacy in higher education".

"Knowing" is also considered as the cognitive-reflective level of the teacher (Adam, 1991). This second competence is related to epistemological knowledge. It should guarantee the development of theoretical teaching actions. Knowledge competences are recommended by (Roessger et al., 2020). The main qualities that this competence provides are:

- Higher mastery of the subject.

- Up-to-date knowledge.

- Mastery of research methodology.

- Mastery of university andragogy.

Knowledge competence enables the creation and generation of online information and material. It also facilitates composing and relating prior knowledge. It also facilitates digital productions, audio-visual texts and software. The "Knowing" competence strengthens the intellectual dependence on the author. It favours the development of digital content. According to (Grünwald et al., 2016), the "Know" competence enables the integration and reworking of digital content.

According to the opinions of the respondents, the most frequent were: "all my students know about ICT", similarly, according to García et al. (2017), students currently have high levels of ICT knowledge. ICT can help educators to build a knowledge society. All this, because they allow the development of innovation capacities that can be decisive in the development of society. They also have an impact on sustainable development at the global level.

The integral competence "Knowing how to live together" is related to "Attitude to ICT in higher education".

The third competence is the knowledge and attitude competence, which is immersed in communication (Alcalá, 1999; Axford, 1976). Digital environments share resources through online tools. The teacher must know how to use and coexist with these means of connection. Connection and communicative collaboration with other teachers are important (Snyman & Berg, 2018). Digital tools help to interact and participate in communities and networks. In this way, intercultural digital awareness is generated (García, 2014). Attitude towards ICT is understood as the affective and communicative dimension (Espinoza et al., 2020). These competences are qualities related to social and communicative skills (International Institute of Andragogy, 1986). Personal attitudes can establish affective and communicative links. For Cela et al. (2017) the most common "know how to live together" competences are:

- Facility for interpersonal relationships.

- Affective personality traits.

- Specific organizational teaching skills.

- Long-term and short-term planning of learning activities.

- Selection of didactic methods

García et al. (2014), mentioned that the university student learning process is vulnerable to the "faculty-student" relationship. Therefore, communications imply an effective relationship in the learning process. There must first be communication, then trust is built. Then mutual respect is formalized. In this way, communication is an essential competence in virtual university education during the COVID-19 pandemic (Yanez et al., 2019).

Roessger et al. (2020) and Beltrán, (1995) stated that, behaviour can be predicted by cognitive psychology.

It also seeks to explain attitudes. Therefore, it is necessary for teachers to express themselves and to be confident.

Among the most prominent opinions: "we must adapt to technology", "students identify with technology", "we can motivate them to study with technology". Carneiro, says that teachers can apply ICT as a motivational and affective tool (2021). Teachers must have responsibility and learn to be affective. Díaz, (2006) affirms that teachers' affectivity must have a critical spirit. In this way, they can analyse all the information that reaches them. Verify what is reliable and what is not. In the same way, determine what is considered important or not.

The integral competence "Knowing how to do" is related to "Educational methodology through ICT".

Among the quantitative outcomes "Know-how" is the fourth competence. Know-how is known as the active-creative dimension (Arocena, 2014). This competence is of an applicative nature in education. It enables all teachers to design, implement and evaluate actions. Develop effective and efficient activities. The know-how competences include:

- Design of didactic materials on the web.

- Application of teaching and learning strategies.

- Assessment of learning.

- Organisation of data and digital files.

Educational methodology identifies the needs of using ICT. This competence is found in problem solving. It is the attitude that the teacher must have to make decisions (Pérez, 2009).

Among the most frequent opinions is the evaluation. "My students do not like activities in 45-minute periods". The time factor in virtual education is very important; when generating a virtual activity, teachers do not study the anxiety variables (Mendoza et al., 2021). In digital assessment Pellón, (2013), he recommends a flexible academic model. Avoid excessive homework and overload of activities. The teacher must have the ability to know how to choose the most appropriate digital tool. Also, the ability to solve conceptual problems through online devices. Use technologies in creative and innovative ways. When presented with connection or software problems, to be able to solve these technical problems. If the teacher identifies technological needs, he/she can establish innovation in a creative way (Azmi & Noer, 2020).

In this sense, Krichesky and Murillo (2018) state that teachers must update themselves to promote innovation. Innovative teaching is putting aside the old to look for what will work in the future (Díaz, 2006). Knowing how to do technological innovation strengthens solutions in the educational context. For López and Pérez, (2017), it is important to implement the epistemological basis of university digital didactics. Digital didactics is innovative and facilitates what is taught in higher education (Centre for Educational Planning and Reflection, 2010). For problem solving, the teacher must be open to reflective criticism (Rodríguez, 2016). Critical attitudes end up being constructive for the teacher (Roessger et al., 2020).

After applying qualitative triangulation of the results. It is known that competence learning is the application of competences. These skills, abilities, attitudes, and values are developed by teachers. The role of the andragogic teacher is to overcome traditional learning models (Chacón, 2012). In virtual education, accompaniment and knowledge construction go hand in hand (Espinoza et al., 2020). The development of competences is a constant skill (García, 2014). It can be indicated that all digital competences are important in Ecuadorian higher education (Mendoza et al., 2019a). However, among the research results, four integral competences have been classified in an orderly manner. These competences establish the correct order in which they should be developed.

Conclusion

In the digital university environment andragogy must be prioritised. Teachers must "learn how to learn". Most university teachers have not learned digital learning strategies. Most were not trained on virtual platforms. During the COVID-19 pandemic teachers are faced with a new task. The method they used was used intuitively. This means that very few know how to deal with the current digital challenges. Teachers believe that students already know everything they must do.

For university teachers it is essential to learn how to learn. The Ecuadorian university is working in a forced digital information society. Due to the COVID-19 pandemic, face-to-face education was not prepared for such sudden changes. For which, it is necessary to know how to organise data and information. Knowing how to select what is most important and relevant. To convert it into digital knowledge to be used efficiently and effectively through university platforms.

To do this, teachers must assimilate, master and implement strategies that allow them to plan and organise. However, current university education in Latin American society is the product of profound changes. Cultural, social, political and economic changes. These changes drive the reality of each social context, in the search for progress.

Universities play a fundamental role in the development of each country. The university promotes the training of human talent, the production of knowledge, science, technology, research and updating. This will allow each nation to benefit from skilled human resources. But if skills remain stagnant in a traditional system, there will be no significant progress. For this reason, the research objective is answered. The digital andragogical competences of Ecuadorian higher education teachers during the COVID-19 pandemic are presented below (see Table 7).

Table 7. University andragogical competencies of Ecuadorian teachers during the COVID-19 pandemic.

University teacher training in ICT	- Apply self-assessment of personal skills and abilities. - Know the platform and its working tools. - Value the means through which communication is established to facilitate learning. - Be an expert and up-to-date professional in virtual platforms. - Learn and implement didactic training models. Models of critical-constructive development. - Understand that research and digital innovation should be parallel components of university education. - Be a lifelong learner in virtual education. - Encourage autonomous learning in the student. Are motivated and willingness as self-improvement.
Technology use and literacy	- Use digital feedback systems. Serve a greater number of students and be assertively informing them of their areas of opportunity. - Demand the generation of new contributions from the student body. - Create change, recognizing that there is no one truth. - Value student experiences. Generate a process of experimentation-action. - Availability of information always and from anywhere. - Ensure that learners are comfortable with the system and the software. - Keep in contact with the university platform administrator. - Monitor students' progress and review activities completed. - Establish the overall course timetable, by modules, assignment submission, and follow-up of the different communication activities. - Establish dates and times for chats and forums. - Use web-based recording media.
Attitude towards ICT in higher education	- Ability to offer their knowledge content to many learners at different times. - Treat the learner with elements of andragogic education. - Hold reflective dialogues. - Foster effective communicative relationships with students to create empathy. - Be supportive and participative in the knowledge society. - Encourage reflection and act with maturity. - Understand that knowledge must be put into practice through virtuality. - Encourage collaborative work. Manage learning groups for work in the network.
Educational methodology through ICTs	- Develop competency-based classes. - Use assessment software to measure competences. - Have independence and time management for better planning. - Establish innovative changes in digital teaching and learning processes. - Develop theoretical-conceptual contents. Favour the comparison of epistemic training in everyday life. - To maintain a corrective and motivating digital evaluation process. - Generate processes of self-evaluation, evaluation and co-evaluation. - Be flexible and not rigid in the deadlines for the delivery of virtual activities and evaluations. Understand that internet or hardware failures may occur. - Offer guidance tutorials for activities, assessments and research. - Ensure that learners are reaching the appropriate level. - Introduce the discussion topic and relate it to previous ones. - Resolving possible doubts arising from reading the teaching materials. Explain how to carry out the activities. - Make overall and individual evaluations of the activities carried out.

Recommendations

The use of digital competences in university education is recommended. Competences facilitate the development of skills that enable effective performance in a digital environment within the educational environment. Digital competence in teaching is the set of skills, abilities, knowledge and attitudes that teachers must have in order to make critical, creative and safe use of ICT in their classes. The pandemic situation (COVID-19) has led many teachers to rethink their teaching-learning processes. In this sense, the importance of assessing and strengthening digital competences is mentioned. To have a better evaluation of the teachers, it is recommended to apply the questionnaire with four variables of data collection. Therefore, a digitally competent teacher is expected to be able to:

- Search and process information into knowledge (make meaning).

- Use digital technology or applications.

- Create content and communicate it online.

- Share their experiences with the teaching community.

- Act responsibly and cater for the diversity of learners.

- Enthusiastically transmit to students the use of technology in the classroom, always aligned with their educational purpose.

It is recommended that future research should study and update the competences proposed. Firstly, to contrast the results with a larger number of studies, even for the same sample. Secondly, to construct new competences and establish new variables ordinally. Construct the same research in a new context, place and/or culture. Thirdly, re-evaluate and extend the theory, framework or model you have addressed in your research. It would be interesting to apply a qualitative research model through interviews and observations of virtual classrooms.

Limitations

The main limitation of the study lies in the fidelity and veracity of the data. It is a multi-method study. Another limitation is the size of the sample. Samples of more than 30 informants are required to generalise the results to be obtained. The design of the data collection instruments must be of ordinal variables. Only 3 or 5 response options, not an even number.

Authorship Contribution Statement

Navarro Cejas: Final review of the study, analysis of the theoretical contents, theoretical underpinnings, research on educational competences, final outline of the study. Cejas Martinez: Design of the questionnaire, division, and generation of variables, data comparison, writing of the digital competences, andragogical analysis. Vinueza Naranjo: Technological analysis, review of the data system, bibliographic review, citation of authors related to the topic of study, scientific writing. Vega Falcón: Application of data collection instruments, qualitative analysis, languages and transcription critical analysis of qualitative data. Mendoza Velazco: Quantitative analysis, generation of tables and appendices of the manuscript, documentary management of the scientific publication, use of the SPSS statistical package.

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Appendices

Appendix 1. Data collection instrument to analyze variable 1. Technology use and literacy

Digital andragogical competences of Ecuadorian higher education teachers during the COVID-19 pandemic	**Research**				
Indicate the grade option: "(5) Strongly agree" "(4) Agree" "Undecided (3)" "Disagree (2)" "Strongly disagree (1)".					
Date: ___/___/___					

N°	**Variable 1 / Technology use and literacy**	**Options**				
1	Knowledge and use of the basic components of ICT	1	2	3	4	5
	Do you use peripheral reads?					
	Do you use external storage?					
	Do you use the whiteboard and projectors?					
2	Knowledge and use of operating systems	1	2	3	4	5
	Do you perform images and presentations in your virtual classes?					
	Do you use the spreadsheet (Excel) or database (SQSS)?					
3	Using the web and its basic tools:	1	2	3	4	5
	Do you use your university's e-mail?					
	Do you use browser software and information search systems?					
	Apply software tools to exchange files?					
4	Do you know and use social media?					
5	Resource management using web 2.0 applications	1	2	3	4	5
	Do you use Blogs?					
	Use Wikis pages?					
	Use forums with your students and video blogs?					
	Design online presentation for classes with your students?					
6	Managing and using tools and storage within cloud environments	1	2	3	4	5
	Apply Google driver software?					
	Apply Dropbox software?					
	Apply Icloud software?					
	Apply Office 365 and skydrive software?					
7	Conocimientos y uso de plataformas de gestión	1	2	3	4	5
	Do you use the Moodle system?					
	Do you use the Blackboard system?					
	Do you use the Teams system?					
	Use or behind virtual educational platforms?					
8	Do you handle device protection software and care in Data Protection?					
9	Do you know and operate tools for the creation of QR codes?					
10	Do you know about personal learning environments?					
11	Use ICT in a collaborative way?					
12	Design lessons with presentation materials, multimedia, video and podcasts?					
13	Do you know about copyright and intellectual property rights?					
14	Do you know how to use bibliographic managers? (Zotero, mendeley, refwork, Word Stylo)					
15	Do you apply effective search and discrimination of relevant information on the web?					
16	Manage online publishing tools	1	2	3	4	5
	Picassa					
	Pinterest					
	Instagram					
	Slideshare					
	Youtube					
	ORCID					
	Facebook					
Can generate an opinion:						

Appendix 2. Data collection instrument to analyze the variable 2. Educational methodology through ICTs.

Digital andragogical competences of Ecuadorian higher education teachers during the COVID-19 pandemic						Research		
Indicate the grade option: "(5) Strongly agree" "(4) Agree" "Undecided (3)" "Disagree (2)" "Strongly disagree (1)".								
Date: ___/___/___								

N°	Variable 2, Educational methodology using ICTs	Options				
1	Implementation of experiences and creation of learning environments with ICT, personalized educational environments.	1	2	3	4	5
	Participate in research and teaching innovation projects? Has teaching experience in the classroom using ICT? Do you participate in learning communities or learning networks?					
2	Using digital content to support	1	2	3	4	5
	Do you present online in all your activities? Apply and design online video? Are all your digital learning resources your own designs?					
3	Inclusion of virtual activities for student acquisition					
4	Structure course activities using virtual university fields					
5	Access to educational resources through different devices					
6	Using web 2.0 tools such as blogs, wiki, podcasts, as an activity for the subject					
7	Plays QR code to compile relevant information about the curriculum. Bibliography of the subject, supplementary information					
8	Performing activities or tasks eat designs, project outline and explanations via QR codes					
9	Using applications to create augmented reality as an educational resource					
10	Ability to create a virtual collaborative learning environment					
11	Digital portfolio designs as an activity for self-development of students					
12	Using video as digital teaching material					
13	Using virtual simulators and video games in the classroom as a digital teaching resource					
14	Provide students with ICT tools for the planning and organization of autonomous learning					
15	Use of cloud accommodation tools to share subject educational material and other material relevant to student training					
16	Evaluation of the achievement of the subject's competencies through the use of ICT					
17	Approach and use of MOOCs as a complementary resource in learning					
18	Use of videoconferencing in class with experts on a field or subject of the subject					
19	Effective development of digital tutoring for educational improvement					
20	Using the whiteboard as a key element of ICT training					
21	Use of social media as a resource within the virtual classroom					
22	Network-based subject learning, collaborative learning, and shared information packages					
23	Evaluation of the methodology through online questionnaires					
24	Management and knowledge of virtual classroom functions					
25	Knowledge and use of tools to create educational activities through augmented reality	1	2	3	4	5
	Applications: learnar, artookit, Aumentary Browsers: layar, junaio, wikitude world browser Knowledge about projects vases in AR: spiral, Venturi					
Can generate an opinion:						

Appendix 3. Data collection instrument to analyse variable 3. ICT training of university teachers.

Digital andragogical competences of Ecuadorian higher education teachers during the COVID-19 pandemic	Research

Indicate the grade option: "(5) Strongly agree" "(4) Agree" "Undecided (3)" "Disagree (2)" "Strongly disagree (1)".

Date: ___/___/___

N°	**Variable 3, ICT training of university teachers.**	1	2	3	4	5
1	Learning and self-taught ICT experience					
2	Ability to solve problems through ICT					
3	Skills for the use of ICTs as a resource for andragogic					
4	Participation in ICT training courses					
5	Training received in ICT through e-learning					
6	Knowledge and integration of the curriculum into virtual educational practice					
7	Lifelong learning of digital competence and educational technology					
8	Training received in the use of mobile devices as a teaching resource					
9	Software training dedicated to data collection research and processing					
10	Are ICTs an intellectual distraction?					
11	Distinction between the different uses of ICT: educational resource, leisure, communication etc.					
12	Participation in ICT-based innovation projects					
13	Dissemination of ICT experiences on the web					
14	Creating and preserving a network of teachers' contacts					
15	Evaluation of their teaching work through the use of ICTs					
16	Understanding of national and international indicators of digital competence					
17	Ability to select and discriminate between different tools and information managers.					
18	Solving learning and diversity care problems through ICT					
19	Understanding of the importance of digital competences for future trainers					
20	Ability to use educational tools in the cloud and create an interactive learning environment with students					
21	Ability to work in personal networks and cloud learning environment					
22	Teaching role as a guide, mediator and learned the learning teaching process					
23	Management and use of ICTs in the process of managing and organizing research teaching tasks					

Can generate an opinion:

Appendix 4. *Data collection instrument to analyses variable 4. Attitude towards ICT in higher education.*

Digital andragogical competences of Ecuadorian higher education teachers during the COVID-19 pandemic		Research				
Indicate the grade option: "(5) Strongly agree" "(4) Agree" "Undecided (3)" "Disagree (2)" "Strongly disagree (1)".						
Date: ___/___/___						

N°	Variable 4, Attitude towards ICT in higher education	Options				
		1	2	3	4	5
1	Virtual learning environments provide a better learning teaching process					
2	The renewal and updating of andragogy k in ICT are paramount in the information society					
3	ICTs offer greater flexibility and enrich the learning teaching process					
4	ICTs provide learning beyond time and space					
5	ICTs allow to promote the creativity and imagination of students, to carry out innovations in their future teaching work					
6	ICTs promote collaborative networking, establishing a network of contacts with experts and professionals					
7	The use of mobile devices encourages the implementation of emerging technologies					
8	Virtual education accessibility is only possible for those who have access to the internet					
9	Applying open-source resources makes it easier for teachers and students to work					
10	ICTs improve the quality of higher education but do not solve the problems that arise in society					
11	The use of ICTs in the teaching methodology increases student motivation					
12	The training offered in terms of andrological anime ICT is sufficient for the professional development of teachers					
13	ICTs have limitations due to technical difficulties					
14	Emerging technologies such as Big Data, Augmented Reality, AnaliticLearning will foster virtual learning environments.					
15	Virtual classrooms have been technician, but their andragogic potential is not used for university education					
16	ICTs are a time investment that is considered wasted by university faculty					
Can generate an opinion:						