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Methodology for University Mathematics Teaching Staff: Emotional-Technological-Ontological Logic Evaluation

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Abstract: The aim of the research was to develop a theoretical approach to describe the emotional and techno-ontological logic of mathematics teachers during distance learning during the COVID-19 pandemic and the impact of their emotional state on the learning process. The research approach used in this paper belongs to the qualitative paradigm. The study involved teachers and students from universities in Ecuador, both private and public. The study observed the behavior of teachers and students, analyzed the use of technology in mathematical activities, and analyzed personal opinions about the learning process of the participants of the study. A digital observation guide and open-ended interviews were used to collect data. The qualitative analysis program Atlas.Ti software was used to analyze the data. The program created three categories: andragogical heterotopia of mathematics, emotional scar in teacher preparation, and perceptions of the educational process. As the results of the research showed, there was a deficit of digital professional training of teachers in the university teaching of mathematics. As a result of the research work carried out, a theoretical approach is proposed, through which it is possible to avoid the manifestation of techno-ontological logical emotions in mathematics teachers in Ecuadorian universities.

Keywords: *Andragogical education, Covid-19, heterotopia, technology, monitoring, learning process.*

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Introduction

The COVID-19 pandemic, which took over the world at the beginning of 2020 and began to dictate its rules, causing many problems, has significantly affected the field of education. Unfortunately, at this point (2022), the pandemic has not completely receded and it is likely that the world may experience other similar situations.

There have been many changes in education, due to the pandemic, as academic activities had to be moved from in-class to virtual mode, thus completely changing the system of teaching, but without worsening the quality of learning. Higher education institutions have a very important connection between the educational and academic components. Also, an important component is the level of professional training of students. This situation favors an interdisciplinary and transdisciplinary approach of the university system.

Andragogic education promotes professional development. The term andragogy refers to the field of adult education. Adult education is more rational and appropriate than the education of children and also has distinctive principles. This educational model also promotes the continuing education of university teachers. On the other hand, there is a number of gaps in knowledge and recognition: gaps in knowledge arise from a lack of knowledge of the circumstances of the case, and gaps in recognition arise from unclear language (Navarro, 2006).

This study proposes to explore the circumstances that arise on a daily basis during a pandemic but that establish new paradigms that lack definition. These circumstances include, for example, the need to define permanent, sudden, and

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unforeseen changes in education worldwide due to global health security measures; the shift from in-class model to an online education system; digital adaptation; and the limits of freedom.

Also, the COVID-19 pandemic had a strong impact on the psychological health of students and teachers. In particular, the level of anxiety increased, and the process of perceiving information became more difficult due to the change in the form of the educational process. Therefore, Van de Velde et al. (2021), and Minihan et al. (2022) studied the problems of the psychological state of participants in the educational process. In their work, they pointed out that teachers, like students, are affected by negative factors, in particular those caused by quarantine restrictions. They also conducted an experiment involving 2 teachers who worked remotely and face-to-face, respectively. As a result, they managed to determine that the indicators of the psycho-emotional state of the second are better in contrast to the teacher who worked remotely. At the same time, in their work they did not establish the sources of the appearance of such factors and the peculiarities of their influence on the consciousness and functions of an educational worker.

Pandya and Lodha (2022) also focused attention on changes in education caused by the spread of the pandemic. They managed to prove that all subjects of the educational process experience strong emotional stress and fears in connection with the transformation of the educational environment. In this case, the researchers pointed out the difficulties of the interaction between teacher-student but did not investigate the role of the teacher as a catalyst of emotional-techno-ontological logic.

In addition, some of the paradigms can be reflected in digital communication, which is one of the main characteristics of the success of the virtual education model. In countries with low financing of the education sphere, as well as a low level of income of the population, problems with the technical support of the educational process may arise. This is explained by the lack of computers and the necessary software for conducting lessons remotely. In this case, it is possible to recommend increasing the level of digital equipment of citizens for unimpeded access to the Internet. On the other hand, virtual education models introduced by educational institutions in South and Central America have not received the expected development (Hurtado Garcia, 2020).

Hurtado Garcia (2020) proved that among the disadvantages of virtual education is the absolute dependence of the educational process on access to technological resources, their speed and connectivity. However, the researcher did not consider ways to overcome such difficulties in order to ensure the smooth implementation of educational activities.

Classroom training was always the primary option, with online classes a close second. Finally, there is a digital divide between public and private education. The digital divide is the difference in access to new technologies and knowledge of their use. Economic, geographic, gender, age or social groups often determine this. For example, digital resources are more likely to be available in private institutions.

Toudert (2018) points out that classroom learning has always been the primary option, with online classes second. In addition, he emphasizes the existence of a digital divide between public and private education. However, in his work he did not reveal the concept of the digital divide, in particular in the context of new technologies and education. Thus, the researcher did not investigate the basis for differentiating groups into economic, geographic, gender, age, or social types.

The digital divide in the Republic of Ecuador is widening, exacerbated during the pandemic. In this study, it was decided to focus on university mathematics teachers, as they must fully master a range of skills, including didactics, andragogy, mathematics, emotion, and technology.

To achieve this goal, the following specific objectives were set:

- To examine the literature related to educational paradigms of heterotopia, emotion, and virtual education during the COVID-19 pandemic.
- Develop a study using a qualitative interpretive approach that includes an observational guide for identifying university mathematics activities and virtual semi-structured interviews with students and faculty.
- To form a theoretical approach according to which mathematical knowledge influences the academic experience in the COVID-19 pandemic.

Methodology

Research Design

A qualitative research design incorporating interpretative methods was used (Aspers & Corte, 2019). The study included a sample of university mathematics students and teachers during the COVID-19 pandemic and data collection consisted of semi-structured interviews (10 questions) and non-participant observation.

Sample and Data Collection

A qualitative research design incorporating interpretative methods was used (Aspers & Corte, 2019). The study included a sample of university mathematics students and teachers during the COVID-19 pandemic and data collection consisted of semi-structured interviews and non-participant observation. Twenty (20) students and eight (8) mathematics

teachers from different public and private universities participated. A total of 14 female students and 6 male students studying in the 2nd year took part in the interview. There were 4 women and 4 men among the teachers. The concepts and opinions most relevant to the object of the study were selected. The audio recordings and transcripts were analyzed using the triangulation method (Atlas.Ti, Theoretical Foundations and Researcher Interpretation). The following are analytical results from the interviews and observations conducted during the study. The software is not designed to automate the analysis process, but simply to help interpret the data. Thus, three research categories emerged directly from Atlas.Ti. The first category is "Andragogical Retrotopia of the Mathematics Teacher." The second category was "The Emotional Scar in Teacher Education." Finally, category 3 was "Perceptions of the College Student."

Research Tools

Two tools were used to collect data. First, a non-participatory observational guide was used (see Table.1). During the study, eight math classes were visited with the mutual consent of teachers and students, without interfering with the learning process.

Table 1. Digital Surveillance Guide

Research by the university math teacher	**Observations**
Time for Math activities:	
Duties, tasks, and digital tools attached:	
Type of platform or virtual system used:	
Organization and structure of classes:	
Student-teacher relationship:	
Behaviors:	
Emotions:	
Affections:	

Second, a semi-structured interview protocol to conduct individual interviews was used. The questions were either semi-open-ended or semi-structured (see Table 2). After completing the 8 class observations, online interviews were requested via email for each math student and teacher. Each interview with both the teacher and the student lasted an average of 8 to 10 minutes. The interview protocol was designed to obtain specific information about faculty and student perspectives and understandings of university mathematics education.

Table 2. Questions asked during faculty and student interviews

Research by the university math teacher	**Date: ____/____/____**
Informant:	
Questions:	
How you define a math teacher?	
Are numerical science easy or complex?	
How you rat virtual math activities?	
What teaching strategy or resource do you recommended to apply in mathematics education?	

Google Meet video conferencing software was used. The interviews were recorded using Loom.com software. The interviews were transcribed using Dragon Naturally Speaking Professional version 13. The coding and analysis were done in Spanish. And selected quotes from participants in the experiment were translated into English.

Information Analysis Procedure

A confidentiality act was drawn up to write the interviews and observation guide. The protocol was shared with the participants and the universities in which they work. The document follows the guidelines of the Committee on Publication Ethics. The document expresses the complete confidentiality of the participants. No incentives were offered to students and faculty to participate. Informant participation was voluntary. Participants were informed that their identity, name, gender, or position would not be disclosed or named in the publication of the study. Ecuadorian universities were open to research projects. A university ethics committee was not required to conduct the study. Researchers respected ethics and confidentiality during the coding in writing and analysis process. Thus, participants felt safe in expressing their opinions in interviews and in class. Coding consisted of assigning a code to each participant (D for teacher, E for student). Thus, for the first teacher D.1. Then sequentially for the second teacher D.2. Similarly, the first student E.1, the second student E.2.

After transcribing the interviews using Dragon Naturally Speaking Professional version 13, coding was developed. The transcripts were carefully checked. Audio and wording were checked for consistency. A systematic interpretive design based on open-ended coding of the interview data was used. This is a scheme in which the researcher identifies and

establishes categories and collects "live coding." They analyze the literal expression of the sample units. Then an "axial category" is selected from all the categories. This will establish connections between the various categories and conduct "sampling coding," which will become the theoretical core. At this stage of the analysis, a "model of the phenomenon under study" is built. Once the categories and their relationships are established, they are compared to the information obtained in other cases. Thus, it is a method based on constant comparison, which will lead to a theoretical approximation or new paradigms (Taipe Castro, 2021).

The interpretive perspective synthesizes some of the problems associated with ontological questions. Ontological issues analyze ways of understanding reality and subject-object relations (Ghorbani & Matourypour, 2020).

The method of triangulation Gaitán Moya and Lozano Ascencio (2013) was used to analyze the results in this paper. The qualitative analysis software Atlas.ti version 20 was used in combination with it. ATLAS.ti is a tool for qualitative analysis of large amounts of information, whether of text, audio, images or video. It contains sophisticated features that help organize, manage, and analyze material creatively and systematically. The triangulation method and Atlas.Ti software allow the formulation of theories (Riccardi et al., 2017).

Theoretical approaches emerge from contrasting qualitative data (interviews, observation, theories, critical author studies, and researcher contributions). Transcripts, audio recordings, research materials, interpretation conclusions were contributed by 3 researchers to Atlas.Ti. The program then created emergent categories by constructing structural networks. The axial relationship of categories provided a theoretical approach to the study (Mendoza Velazco et al., 2020).

Findings

Category 1. The Andragogical Retrotopia of the Mathematics Teacher

Consider students' contributions to the interviews. Student E.2's statements: "My math teacher always emphasizes the nostalgic past". Nostalgia is triggered when a person recalls times that were most likely wonderful. When people experience nostalgia, they recall an idealized past in a combination of many different memories. Integrated memories in which all negative emotions have been filtered out in the process. In other words, according to these expressions, there is a tendency to forget negativity more easily. Thus, only positive memories remain in the memory. People tend to remember the good experiences of childhood: friends, pleasant moments during games, toys, but they forget moments that were not so good: failures, punishments, bad grades, etc.

Similarly, E.5 states, "The teaching of mathematics has produced the best academic results in previous years". This statement suggests that mathematics instruction prior to quarantine was of a higher quality. Also, teachers were more attentive to students' academic performance. While in distance learning, almost most assignments are easier and faster to solve. Because students can use examples of solved assignments on the Internet. Teachers should take advantage of technology to support pedagogical goals. This allows students learning course content in a way that supports specific and measurable learning goals.

As for participant E.18, he expressed, "It's hard to understand classes because everyone in the virtual classroom has to agree on questions or doubts". The learning strategies and tools developed aim to test the theory-question-experience relationship of disciplinary knowledge. A student who knows how to establish this relationship will undoubtedly be competent in professional activities. In virtual education, information is a competitive factor, but it is even more important to know what to do with it. Assessing this situation is crucial to evaluating learning.

According to the full-time E.20 student, "Two years ago, when we were in class, we could ask questions, and we were more comfortable and practical with the exercises." In andragogical education it is important to take into account that mathematics is not the favorite subject of many students. Therefore, mathematics must be taught in an active and playful way. For online mathematics, teachers must have great patience and meaningful teaching skills, demonstrating to students that the exact science is not difficult or complicated.

Student E.15 expressed the following thoughts: "Teachers need to recognize that we are using digital resources to solve computational problems, so there is no point in virtual education". For students, technology tools are more than just a computer or connectivity software. These tools include a variety of teaching techniques. Technology makes it easier to verify the actual procedure and solution calculations. On the other hand, once users have mastered its use, it is suitable for individual work. It can also be used in groups of two or three students as a tool to speed up the class rather than hinder it.

Consider the teachers' contributions to the experiment. Teacher D.2 in his interview emphasized the use of technology tools: "Calculators or math operating systems like Wiris and GeoGebra, which solve everything". The use of technology tools is a digital competency for the teacher. The usefulness of GeoGebra software as auxiliary tools in the classroom facilitates the presentation and theoretical development of topics. It also helps to understand symbolic calculations such as integrated graphical functions.

Teacher D.3 emphasized the following: "Many teachers feel uncomfortable or irritated when they see a student solving problems using digital systems, which is a barrier to meaningful learning". For teachers, the use of technological tools reduces the effectiveness of mathematics instruction. In contrast, adapting technology to the mathematical world can help make the subject more appealing to students. It encourages independent work outside the classroom and at the same time increases motivation.

With the help of Atlas.ti software, by comparing the data, evidence, and theoretical foundations, the first category (see Fig. 1), called the andragogical retrotopia of the university mathematics teacher, was deduced. As the previously induced testimonies of teachers and students show, there are unresolved problems in the virtual learning process. The andragogic retrotopia of mathematical being is based on the constant thought that face-to-face mathematics education is better than virtual education. It is inherent to teachers to think and lament that students will not make any cognitive progress through online education.

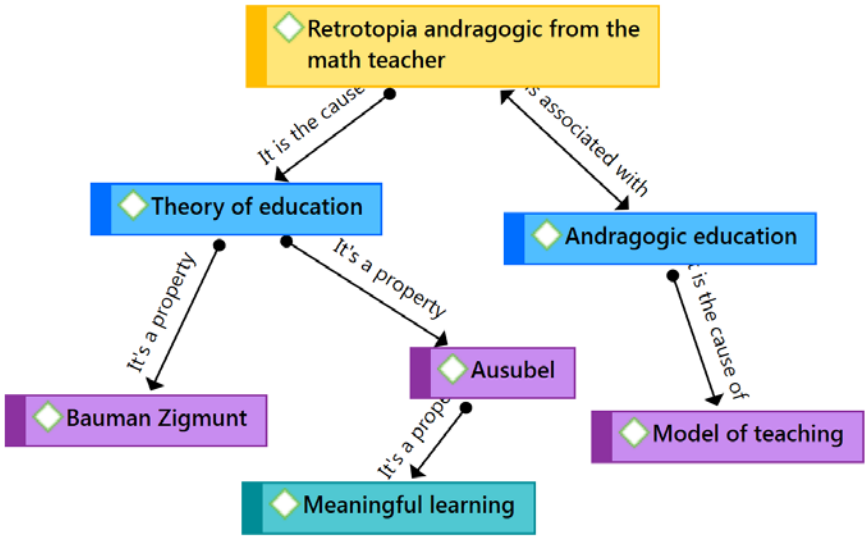

Figure 1. The Structural Network of the Category of Andragogic Retrotopia of Mathematical Being

Category 2. Emotional Scarring in Teacher Preparation

Student contributions to the interview conducted. Student E.18 emphasized that: *"Teachers are eager to get back at us".* According to the students, they believe that in the past teachers were trained in a rigid way. They were trained without technological support, but today they want to use the same teaching methodology (Mendoza et al., 2021).

Student E.11 states that *"Many math teachers give me a reaction of sadness, anger, and fear".* The culture of Ecuador and many developing countries has a symbolic characteristic of the mathematics teacher. Ecuadorian society considers a mathematics teacher smart because they have many successful students. A teacher who inspires unquestioning respect for their discipline is also held in high esteem (Flores Hinostroza et al., 2021). These attitudes and behaviors generate hatred or aversion to mathematics as a subject.

As for study time, for E.6 *"We have the worst adversary - time...".* According to students, the time factor is a point that is not taken into account by teachers, because in online education time can change for many reasons. For example, assignment delivery, Internet connections, and power outages can delay classes (Mendoza et al., 2021).

Similarly, according to E.1, *"When the teacher assigns us a report, he only gives us 50 minutes. I get worried when I solve 20 exercises. The worst part is that he doesn't measure the time, that we have to take pictures, scan the exercises, and then upload them to the Teams system. They don't understand that there can be problems on the internet. What can I do if my computer isn't working properly?"*

According to Anggraeni et al. (2021), the terminology of math anxiety is sometimes used ambiguously, almost always with different meanings in each case. On this basis, math anxiety as an emotion has its origins in a fear of encountering mathematics, which includes lessons, homework, and grades. This concept is also based on physiological studies by Cosic et al. (2020), who found an important relationship between fear-related manifestations and those observed in terms of math courses and exams. Student E.11 says that when it comes to virtual grades, *"I always suffer from anxiety. I don't know if I have enough time."* Similarly, E.2 *"Once I had a power outage and turned in an assignment a few minutes late. My grade was two points lower."*

This factor is due to the teacher's lack of evaluative comprehension competence. If the teacher does not have evaluative comprehension competencies, the teacher will conduct assessments in what are considered normal conditions, where

there are no difficulties caused by factors external to the cognitive (Escalera-Chavez et al., 2016). Regarding problem-solving methods, E.3 states: *"I try to do factoring exercises. That way I have time to correct and check. But the teacher gave me a bad grade, he wants me to solve only as he says."*

Teachers should give free rein to the problems and allow students express their individuality. It is a big mistake when instructors force students to solve problems according to a well-defined scheme. In mathematics assessment, results should be evaluated by outcome, not by procedure (Harjule et al., 2021). This is because there are different ways to solve math problems. Disciple E.7 says that *"Fear was instilled in the teachers."*

Often at the ontological level in Ecuadorian and Latin American education, fear emerges because the teacher is extolled as the model who possesses the only flawless knowledge (Flores Hinostroza et al., 2021; La Madriz Gonzales & Mendoza Velazco, 2018).

Faculty Contribution. According to faculty testimony, D.1 states, *"Students always lie in their grades. The Internet is always broken, the electricity is always broken, the cameras are always damaged. They do it with the intention of copying the results."*

Most teachers think there cannot be a problem with connectivity. And they think that students use the Internet currently to search for answers. The influence that teachers have on grades can lead to changes in attitudes (positive or negative) towards mathematics. It can also change the motivation to learn them, anxiety, sympathy, usefulness and confidence is a fact. In virtual education, because there are no assessment tools, such as a "secure exam browser", the teacher will not be confident in the results obtained (Sepúlveda Obreque et al., 2017).

For teacher D.3 he says, *"Our professional training was pedagogical, but not andragogical."* A teacher's academic training often consisted of supervising children or adolescents. But to qualify for higher education, teachers need to have quality andragogical training. Because adult education is based on different principles.

Moreover, for D.5, there is a *"Lack of Continuing Education in Teacher Professional Development."* And D.7 thinks, *"Having received rigorous academic training, they will give an equal education to their students."*

Teachers of mathematics must receive continuous professional development in order to acquire new knowledge and learn new educational methods. The personal growth of teachers, as well as their high professional training, always has a positive impact on the knowledge of students. The lack of continuous training of teachers, in other words, stagnation in place, has a negative psychological impact, generating emotions of anger, dissatisfaction and fear that can be transmitted to students (Mendoza et al., 2021).

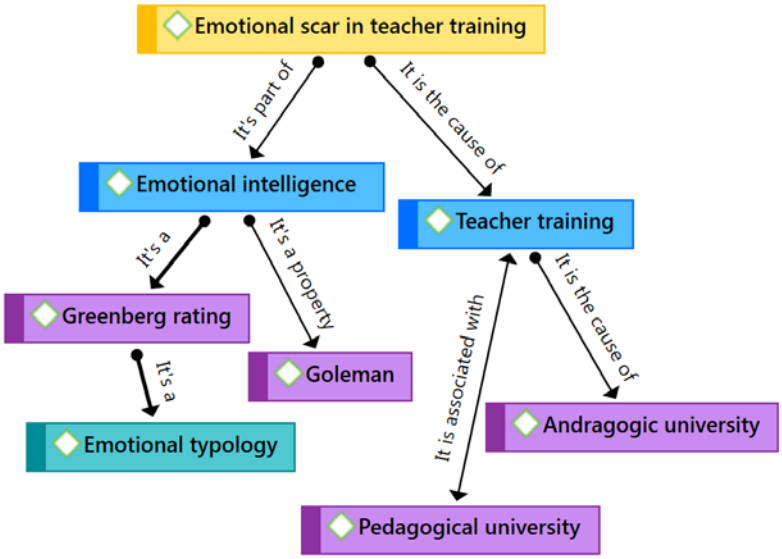

Figure 2. The Structural Network of the Emotional Scar Category in Teacher Training

The second category was defined as an emotional scar in teacher education (Fig. 2). The emotional component is an integral part of the learning process. This category was based on Young and Suri's (2020) theory, which is the existence of six main emotions - joy, anger, fear, sadness, surprise, and disgust. Also, the second equally important theory is the theory of emotional intelligence, which explains the ability to feel the emotions of others and recognize those of one's own. These theories explain the second category.

Emotional scars in teacher education relate to a person's internal emotional perception; they relate to emotional intelligence. Emotional intelligence analyzes how a person can understand and make sense of themselves. The scars refer to emotional pain from the past when a math teacher suffered from poor training, resulting in creating strong and harsh

student evaluations. If a math teacher received very harsh academic training, that teacher would retaliate against students. Revenge is visualized as an emotional scar, a wound from the past that they will want to heal later by making strong demands on the students. Since the teacher cannot make demands in person nowadays, they make demands virtually, these demands in virtual education are what slow down the learning of mathematics.

Category 3. Educational perception of the university student

Student contributions to the interview conducted. Informant E.13 says, *"My teacher always tells me to solve the exercises the way he teaches me, the way he asked and not to do other things he didn't ask for."*

By not giving students the opportunity to solve math problems on their own, by using a more understandable method for the student, instructors deprive students of the opportunity to think. And also, the excitement to learn is lost. Because the ability to think is formed through constant intellectual activity and social interaction. E.19 points out, *"I perceive the teacher as a very fearful person."* Informant E.20 defines a university mathematics teacher as *"a very tough person who makes no mistakes in exercises."*

It can be noted that students have formed an idea of the teacher as a strict and fearful person. Accordingly, such psychological attitudes will have a negative impact on students' academic performance. According to E.1 *"When I was a child, I remember my parents saying that teachers were always right. Now that I'm in university, I look at things differently."*

In most families, teachers are vaunted as an elitist being. Children are psychologically instilled with fear of teachers from childhood, but as an adult they come to understand the imperfection of the educational system. According to E.3 *"It's not the same as being graded by a machine and being graded by a teacher. The teacher used to check me, and sometimes he could take my results into account. But practically, if even one value is wrong, the whole result is negative. Thus, I get a bad result."*

In terms of recommended resources or strategies, E.17 mentions *"We need digital didactic activities. We need the teacher to interact with us in a practical and digital way."*

Digital skills and the ability to use modern technology are an integral part of successful distance education. If during full-time education such skills in teachers were welcomed, but were not so important, now it should be included in professional development courses for teachers. For E.18: *"The teacher sets up a camera and uses an acrylic board. This is the same technique as in a face-to-face class.* This comment is a confirmation of the lack of necessary digital training of teachers.

Faculty Contribution. According to D.6, *"We have to keep the class under control or these kids will make a mess."* Teachers tend to keep control over the entire educational process, without letting the students go. Therefore, it is not uncommon for them to instill a sense of fear in students, which is a very negative psychological attitude (Alves et al., 2018).

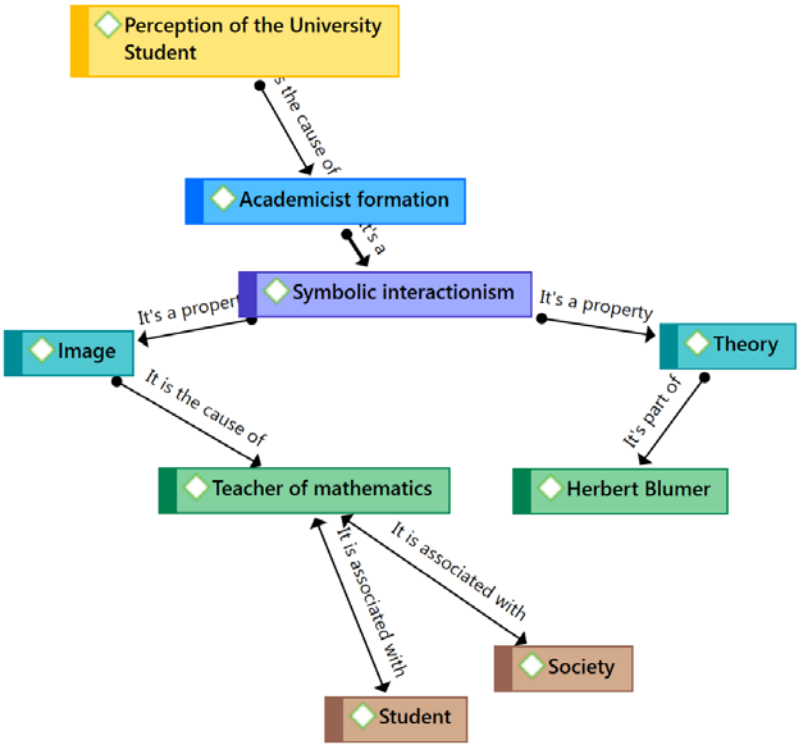

Figure 3. Structural Network of the Category of Educational Perception of a University Student

The third category, labeled the educational perception of the university student, is depicted in Figure 3. Students perceive that math instructors do not feel comfortable with virtual education. Math instructors demonstrate apathy and aversion to the virtual system. Students demonstrate greater mastery of technological tools; they are always in the mainstream of digital connectivism. According to the observations, the Ecuadorian student has always been within the framework of behaviorist or academic learning. Students feel that they are poorly guided in the teaching and learning process, they also notice the poor professional training of teachers.

Discussion

Due to the relevance of exploring and improving the quality of education in times of pandemic, including andragogical education, this study aimed to explore the logical techno-ontological emotions that exist in university mathematics teachers. After comparing the testimonies of teachers and students, theories and interpretations of researchers, the university mathematics teacher is seen as an axis of catalyst, which consists of emotional, technological and ontological components in the teaching process.

Salinas and Garrido (2022) managed to prove in their work that the organization of distance learning requires mandatory retraining of teachers. Thus, the researchers found that such an approach is necessary to achieve the educational goals of students in the modern educational environment. The results of their research and the conclusions in this paper have common features, namely, they equally establish a connection between cognitive-emotional interaction and the level of technological competence in educational workers. Thus, a common position is that the lack of digital skills causes negative emotions and insecurity among teachers. At the same time, approaches to the retraining of teachers are distinctive in the works, as Salinas and Garrido (2022) propose to carry it out simultaneously with teaching activities. At that time, in this study, attention was paid to special courses for teachers in extracurricular hours.

In turn, Al-Badi and Khan (2022) investigated the difficulties in the educational process that were caused by the lack of technological competence of teachers. They mainly focused on the process of adaptation to the new education system, which is quite long and complex. With this in mind, they recommend improving teachers' skills with digital technologies such as online lesson platforms, online classroom management, assessments and exams. In this case, such a position has common features with the results of this work, since it is about retraining teachers in order to increase their level of digital literacy. This approach reveals the same principles of providing a modern educational environment, described in both works. At that time, there are different approaches to students for whom the distance learning process is not wild and scary. Accordingly, compared to Al-Badi and Khan (2022), this study found that students are characterized by optimism in learning, using new technologies and methods. Because young minds are open to new technologies and want new opportunities. At that time, this study focused on the differences in the attitude of teachers and students to the organization of distance learning.

Al-smadi et al. (2022) indicated in their work that most students are dissatisfied with the quality of online classes and the technical training of teachers. He came to this conclusion as a result of conducting a pedagogical experiment, during which the influence of remote activities on the perception of students was studied. His conclusion differs from the results of this study, as it extends the idea of the low effectiveness of distance learning. His position regarding the fact that in remote mode it was more difficult for teachers to interact with students, accordingly, students' interest in classes decreased, is excellent. A similar position with the previous author is held by Mukuka et al. (2021), who conducted a survey among 1st-2nd year students at various universities. Based on this, he found that the majority of students who participated in the experiment believed that mathematics is best studied face-to-face, when there is an opportunity to communicate with the teacher and students in person. This approach differs from the position revealed in this study, as it indicated the possibility of organizing a virtual educational environment, in particular, conducting mathematics lessons.

With this in mind, Minihan et al. (2022) in their study concluded that most teachers face emotional burnout, high levels of stress, and exhaustion due to their professional activities in the context of the COVID-19 pandemic. This approach has common features with the results of this article, as it confirms the overload and undervaluation of teachers. The ideas for solving this problem are similar, namely to ensure realistic expectations of employers, to influence the reduction of the load on teachers, to carry out continuous professional development and training.

At the same time, Salinas and Garrido (2022) indicated such a factor as the emotional impact in everyday life, which is caused by the lack of communication and the general stress associated with quarantine. Thus, the effects of various circumstances on the emotional, cognitive, and behavioral levels of students' consciousness are significant. The difference in the obtained results may be influenced by the age of the interviewed persons, based on the results of which the study was conducted.

Contrary to the findings of this study, Pandya and Lodha (2022) believes that the emotional well-being of students is related to how they relate to their academic activities. This approach is different from the one discussed above but can be used to develop recommendations for avoiding mental health problems. For example, academic institutions can implement numerous activities for students, such as telecounseling services, online support groups, and mentoring sessions.

As can be seen from the study by Ghorbani and Matourypour (2020), the COVID-19 pandemic had a significant impact on students' academic performance and emotional well-being. This conclusion shares common features with the results of this work, which also revealed a clear correlation between students' psychological health and their use of online learning. The similarity of the obtained conclusions suggests a positive correlation between the digital tools used for online learning and student success.

Atlam et al. (2022) and Clark et al. (2021) succeeded in highlighting the specific impact of various factors on the academic performance of distance learning students during the COVID-19 pandemic. In particular, students did better on exams when they were taught online lessons recorded by more qualified teachers. This conclusion coincides with the results obtained in this study, in which it was also proved that the use of computers by students is more effective than smartphones. Taking into account the above, it was possible to identify common and distinctive features between the works of various authors and the conclusions of this article in the context of research on the issue of the implementation of andragogic education, as well as its emotional component.

Conclusion

The article developed a theoretical approach to describing the emotional-techno-ontological logic of mathematics teachers during distance learning during the COVID-19 pandemic and the impact of their emotional state on learning process. As the results showed, the teachers were not satisfied with the distance learning format because they believed that the process needed improvement.

It was possible to answer the question relevant in scientific doctrine regarding the emotional problems faced by teachers, namely emotional burnout, depression, aggression, etc. At the same time, proving the fact that educational workers feel nostalgia and apathy is new for pedagogical doctrine. Therefore, future researchers can continue to analyze the emotional state of teachers, which has a significant impact on students. The priority of this issue is due to the peculiarities of the educational process, during which there is a close emotional contact between its participants. Based on this, it was possible to fill the gap in the scientific literature regarding the identification of the role of the teacher with the catalyst of emotional-techno-ontological logic.

After analyzing the testimonies described by the informants, the interpretations provided during the research, and the theoretical contexts using a system of qualitative analysis, it can be concluded that at the time of the research, there was a large shortage of training of mathematics teachers for distance learning in universities. Thus, it was possible to reveal a new vector in the pedagogical doctrine regarding education in Ecuador, as well as the sources of a negative emotional state that suppresses development processes.

The results of the research can be used in the future both for the construction of new distance andragogical education programs and for the development of scientific pedagogical doctrine in this context. In addition, the obtained conclusions should also be taken into account when preparing teacher training courses. The information obtained by the students can be a theoretical basis for further research and for comparing the results with research in other countries. In the field of psychology, this study will be useful for studying the logical techno-ontological emotions of university teachers.

Recommendation

The researchers recommend that future research be established based on:

- Assessment of teacher preparation: It is important that university mathematics teachers prepare their classes adequately. This includes reviewing the material to be taught, preparing examples and exercises, and ensuring that the content is adapted to the level of the students.
- Analyze active teaching: It is recommended to analyses active teaching methodology. Assess active participation in the class. Review teamwork, group problem solving, etc.
- Feedback: It is important for university mathematics faculty to provide constant feedback to students. This can be through homework review, in-class comments, or exam marking.
- Assessing the effective use of technology: Technology can be a useful tool for university mathematics teachers. Analyze whether it can be used to improve teaching skills. Demonstration and examples, as well as for conducting assessments.
- Applying multi-method or mixed assessment. Develop a qualitative and quantitative paradigm study to verify the assessment of emotional intelligence in mathematics teaching. Develop a study with a larger population to assess feelings and attitudes towards mathematics. To assess the levels of stress they feel when studying for and passing mathematics exams.

In the following scientific works, it is expedient to focus attention on methods of using artificial intelligence for teaching students of mathematical sciences, as well as checking their works. Accordingly, it is expedient for researchers in the future to determine the advantages and disadvantages of involving artificial intelligence in the educational process.

Limitations

The study is limited by the fact that it was conducted under the qualitative paradigm. Only twenty (20) students and eight (8) mathematics teachers from different public and private universities participated. The study was carried out in the Republic of Ecuador. Eight (8) classroom observations were carried out. Semi-structured interviews were conducted with questions that facilitate the study objectives.

Ethics Statements

Studies with human participants were reviewed and approved by UTE University. Participants gave written informed consent to participate in this study. They were informed that the results would be coded. It was determined that the first and last names of those interviewed would not be used.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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Authorship Contribution Statement

Mendoza Velazco: Theorization and conceptualization of the results. Application of the Atlas.Ti analysis. triangulation of the results. Navarro Cejas: Triangulation of testimonies. Structuring of the study. Revision and application of structural networks. Cejas Martínez: Documentary and bibliographic review. Review of the theoretical bases. Varguillas Carmona: Review of the APA norms 7th edition. Application of the interviews.

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