NEW TRENDS AND RESEARCH ON DIGITAL EDUCATION, TECHNOPEDAGOGY AND CURRICULUM

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PREFACE

"To deify or demonise technology or science is a highly negative and dangerous way of thinking incorrectly"

Paulo Freire (1921-1997)

The effective integration of technology in education is generating new guidelines and research trends in the initial and continuous training of teachers based on technological, pedagogical, and curricular knowledge. These components, when combined, complement each other and generate new knowledge, such as techno-pedagogy (technopedagogy), digital content technology (digital education), and content pedagogy (curriculum), which interact and effectively integrate into teaching and learning processes, allowing for the identification of strengths and weaknesses in educational practices.

In recent decades, especially during the Covid-19 pandemic, teachers have adopted pedagogical strategies mediated by Information and Communication Technologies (ICT) to transform and renew educational practices, leading to a redirection of the teaching and learning process. This requires innovative practices and essential scenarios for the pedagogical integration of digital technologies, where the quantity, quality, and diversity of technological equipment are renewed and enriched to significantly contribute to students' skill development and learning outcomes.

Education must change because the current world has distinct characteristics and requirements than the society in which it was created. The key is not simply to incorporate technology into the classroom, but to understand the purpose of using technology when delivering specific content. Therefore, the challenge is to appropriate technology in the educational system, transform education, find opportunities in educational spaces, and adopt a teaching profile capable of overcoming difficulties and obstacles encountered in the educational system, such as the absence of pedagogical strategies and planning. This involves designing, developing, and transforming educational practices according to the current curriculum. From this perspective, digital pedagogy or technopedagogy is a structured approach that allows teachers to positively impact learning through the proper application of active methodologies and the use of technological tools and digital practices that facilitate knowledge internalisation.

Digital teacher education involves adopting appropriate technology for a particular disciplinary or scientific content through pedagogical strategies that respond to student learning. It includes designing training proposals,

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training courses, and academic programs that are developed with technological mediation in virtual learning environments and in different study modalities.

"New trends and Research on digital education, technopedagogy, and curriculum" is a reference for teachers who integrate ICT in their teaching and learning processes, as it offers an updated, courageous, and accurate guide on how educators think, process, and communicate their knowledge and techno pedagogical practices. It becomes a reference for redesigning the curriculum and policies of initial and continuous teacher education, empowering new teaching models, approaches, or paradigms, improving teaching didactics through the use of didactic strategies for virtual environments, and recognizing the need to maintain constant interaction with technological tools for learning. This requires continuous practice and the development of digital and research competencies in teachers and students.

In conclusion, this book is an important contribution to understanding, from different perspectives, the potential and weaknesses of digital tools in the classroom. It promotes reflection and debate about their role in the lives of children, young people, and teachers in initial and continuous education. The twelve chapters cover diverse topics related to the use of technology in education, such as the potential of educational robotics, collaborative methodologies, digital platforms for science learning, and the flipped classroom approach, among others.

Freire's quote in the introduction remains relevant: "To deify or demonise technology or science is a highly negative and dangerous way of thinking incorrectly." It invites us to adopt a critical and balanced approach, acknowledging that technology and science are powerful tools that can be used for both good and harm. It depends on us, as a society, how we use them in our teaching practice. Having an open and reflective mindset allows us to assess the impacts and consequences of technology and science properly and make wise decisions that promote the common good. Finally, it is important to emphasise that technological advancements are valuable and can contribute to education, but only when they are used as instruments in service of humanity, never as substitutes for human beings.

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CHAPTER 1. STUDY ON THE DIGITAL TEACHING COMPETENCES OF STUDENTS IN THE MASTER'S IN EDUCATION PROGRAMS AT THE ESCOLA SUPERIOR DE EDUCAÇÃO DO POLITÉCNICO DO PORTO

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I. Introduction.

1.1. Theoretical basis and foundations

Information and Communication Technologies (ICT) have deeply permeated all aspects of education, bringing about profound changes in teacher education and practice (Matías, Bartet, & Rozados, 2010). Educational institutions at all levels are increasingly demanding the incorporation of these powerful resources.

ICT is an integral part of an ever-evolving and ongoing learning process (Delgado et al., 2015) that creates new avenues for teaching (Cabrera, 2016). To meet the challenges of the present and future, professionals with high levels of digital competency are necessary. Among the groups that require this training the most are university students, particularly those who aspire to become educators or work in the field of education.

Some studies have revealed that this group often lacks training or needs improvement in the area of ICT applied to teaching (Chancusig et al., 2017). In response to these training needs, curriculum plans increasingly include

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modest proposals for teacher training in ICT; however, substantial efforts are still required to achieve a population with a high level of digital competence. Initiatives such as the European Framework for Digital Competence for Educators, known as "DigCompEdu," have been created to enhance the digital competence of teachers (Cabero & Palacios, 2020).

It is crucial to emphasise the significance of technopedagogical training for future education professionals, as the evolving challenges in the teaching field necessitate the restructuring of paradigms to establish accessible and high-quality education. In this regard, the use of ICT in continuous professional development processes influences teaching and learning (Pando, 2018).

Next, we will examine some recent research studies that underscore the importance of ICT in 21st-century educational institutions:

In a study, Jorge and Santich (2020) aimed to create, implement, and validate a model that would enhance the digital teaching competence of active teachers in secondary schools. The focus was on generating didactic strategies to effectively integrate technology into their teaching practices. The study was conducted in the town of Rio Gallegos, situated in the Southern Patagonia region of Argentina. The goal was to provide teachers with the necessary tools and skills to effectively use technology in their classrooms and enhance their overall teaching abilities.

Cabezas et al. (2020) conducted a study examining teacher training at the Catholic University of Santiago de Guayaquil in Ecuador. The study focused on the knowledge, mastery, and application of digital competence among teachers for their own professional growth and the enhancement of teaching and learning processes, with a particular emphasis on first-year university students. The researchers employed a mixed-methods approach, which involved administering a questionnaire to thirty teachers and conducting two focus group discussions. The findings indicated that teachers expressed a keen interest in comprehending and integrating digital competence into their teaching practices. The study also highlighted the significance of improving teaching, learning processes, and cultivating a culture of professional development in the academic institution.

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Ruiz et al., (2021) conducted research with the objective of determining the relationship between attitudes towards ICT and the utilisation of virtual teaching-learning environments among teachers at the University of Huánuco (Peru) during the COVID-19 pandemic. Notably, the findings revealed that frequent usage of virtual environments is associated with a positive reception of ICT and highlighted the need to strengthen capacities in utilising virtual environments for educational purposes.

Perea and Abello (2021) analysed the disparity in perceptions between students and teachers regarding the development of their digital competencies across various variables such as study modality, academic approach, professional experience, and academic training. The results concluded that both students and teachers perceive their ICT skills to be at a medium-high level, with students in distance education and pedagogical programs exhibiting a better grasp of these skills.

Flores et al., (2021) focused their research on determining the significance of teachers' adoption and adaptation of ICT in the classroom and its impact on the teaching-learning process of students. The study emphasised the necessity of approaching the use of new technologies from systemic-practical perspectives.

Ferrada et al., (2021) examined the level of preparedness of teachers in the field of ICT during the COVID-19 pandemic. The results revealed that prior to the pandemic, 78% of respondents were already using ICT, 30% lacked adequate training, and 36% felt prepared to educate their students through ICT.

Martín et al., (2021) accompanied six public universities in Peru during their transition to virtual education for a duration of 157 days of the pandemic through a project in collaboration with the Peruvian Ministry. This study unveiled "opportunities for improvement in technological education training for professionals in institutions, leading to the design, development, and implementation of a scalable and comprehensive training program consisting of 83 courses" (p. 2).

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The aforementioned research studies highlight the imperative of enhancing teachers' digital competencies (Cabero & Palacios, 2020), a notion that has gained particular significance during the period of confinement and remains an unfulfilled objective for educators due to the evident lack of digital literacy.

Taking into consideration these background factors, a research study was proposed with the aim of implementing a pre-designed training program to develop the digital teaching competencies of the target individuals. The sample consisted of twenty university students from the Escola Superior de Educaçao at the Instituto Politécnico do Porto (IPO) in Portugal, who underwent a technopedagogical training process focused on teaching practice.

1.2. Description and Objectives of the Innovation and Research Project

The project being presented is called “Programa de Formação de Competências Digitais” ("Digital Skills Training Program", in English) and its aim is to investigate the level of digital competence of teachers, as well as to provide them training in the field of educational technologies so they can apply digital skills to educational contexts and enhance their future teaching practice, following the Common Digital Competence Framework for Teachers (CDCFT).

The **general objective** of the project is "to implement a previously designed training program that enables the recipients to be trained in the field of digital competencies."

The **specific objectives** are as follows:

- Define a competency framework for action in the field of the Technologies for Learning and Knowledge (TLK).
- Evaluate the digital competencies of the participants through a pre-designed initial questionnaire, based on the Common Digital Competence Framework for Teachers (CDCFT), prior to the training process.
- Evaluate the digital competencies of the participants through a pre-designed post-questionnaire, based on the Common Digital

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Competence Framework for Teachers (CDCFT), following the training process.
- Identify the needs and deficiencies of the participants in the study regarding their digital training.

In relation to the **study hypotheses**, the following are formulated:

- **H_1.** The participants in the study have an overall B1 level in teaching digital competencies according to the CDCFT.
- **H_2.** The participants in the study have an overall B1 level in Dimension 1, Information and Information Literacy of the CDCFT.
- **H_3.** The participants in the study have an overall A2 level in Dimension 2, Communication and Collaboration of the CDCFT.
- **H_4.** The participants in the study have an overall B1 level in Dimension 3, Digital Content Creation of the CDCFT.
- **H_5.** The participants in the study have an overall B1 level in Dimension 4, Security of the CDCFT.
- **H_6.** The participants in the study have an overall A2 level in Dimension 5, Problem Solving of the CDCFT.

II. Methodology

This section presents the methodological framework of the research. This framework establishes the research design, the phases in which the study will be structured, the population and sample of subjects for the study, the data collection instrument, and the data analysis.

2.1. Methodology of the innovation and research project

The methodology used in this study followed a descriptive quantitative approach in its "survey" modality for the research part, as well as a Cooperative Learning approach and the inclusion of Information and

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Communication Technologies (ICT) for the application of the digital competency training program.

The research design in this study revolved around a descriptive survey, a widely used model in the fields of Education and Social Sciences. This type of research involves the use of questionnaires or surveys as data collection instruments. To this end, a self-assessment questionnaire for digital competencies was developed as the data collection instrument.

Regarding Cooperative Learning, it constitutes a teaching-learning structure in which participants have common objectives, and one participant will achieve their goals if others also achieve theirs, implying a cooperative relationship among them. Moya and Zariquiey (2008) identify the elements that shape this approach, including heterogeneous groupings, positive interdependence, individual accountability, equal opportunities, interaction among group members, cognitive processing of information, use of cooperative skills, and group evaluation.

The inclusion of Information and Communication Technologies (ICT) constitutes a methodology that aims to integrate various telematic tools into learning processes through dynamic approaches, where interaction among participants is crucial to ensure a high-quality teaching-learning process. Among the various submodels of ICT integration in educational processes, the Computer Supported Collaborative Learning (CSCL) approach was chosen as the methodology supporting some intervention project sessions. This teaching-learning model is based on a socio-cultural perspective of cognition and reinforces the idea that ICT have significant potential in creating and enriching interpersonal learning contexts (Salmerón et al., 2010; Kolloffel et al., 2011).

Regarding the study **population**, it was established among **all students of the Escola Superior de Educação at the Instituto Politécnico do Porto (ESE-IPO)**, from the **Mestrado em Educação Pré-Escolar e Ensino do 1.º CEB**, the **Mestrado em Ensino do 1.º CEB e de Matemática e Ciências Naturais no 2.º CEB** and the **Mestrado em Ensino do 1.º CEB e de Português e História e Geografia de Portugal no 2.º CEB**. The **sample** consisted of **20 students** from these degree programs.

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2.2. Organization and project management

The innovation and research project followed these phases:

- **Phase 1. Diagnostic Phase**. In this phase, the initial actions of the project were carried out: introduction to research, formulation of objectives and hypotheses, design of the methodological framework, selection of the sample of subjects, and diagnosis of the digital competencies of the subjects through the administration of the pre-test questionnaire on digital competencies.

- **Phase 2. Development of the Technopedagogical Training Process.** In this phase of the project, the Technopedagogical Training Project was outlined, which included the initial questionnaire (pre-test), the final questionnaire (post-test), the competencies, and the digital tools that served as training for the participating subjects. The training process consisted of 30 hours, which were conducted due to the critical epidemiological situation. The central objectives were focused on digital competencies and their application in teaching and learning processes.

- **Phase 3. Generation of Results from the Technopedagogical Training Process**. In this phase, the results obtained from the research were examined, including both the pre-test and post-test questionnaires and the development of the digital competency training course.

- **Phase 4. Presentation of Results and Dissemination**. In this phase, the preliminary results of the study are presented, conclusions are drawn, as well as the identified limitations, relevant proposals, and future lines of research and application are discussed.

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2.3. Data Analysis

After designing and administering the questionnaires to the research participants, the analysis of the collected data was conducted. The obtained data were predominantly quantitative, so an-Excel data matrix was used to record all the information by dimensions and individualized items. Global means for dimensions, items, and both individual and collective forms of the participant group were also calculated.

Additionally, different levels were established following the MCCDD. The analysis was conducted based on the following parameters:

- **First question of the pre-test and post-test**. In this question, participants were asked, from their perspective, about their level of digital competence based on the six levels of the framework: A1, A2, B1, B2, C1, and C2.

- **Questions from competency areas**. Each competency area consisted of different items offering five possible answers. Since the A1 competence level is the most basic, it was agreed to establish the remaining levels so that answers corresponding to option 1 were associated with level A2; those corresponding to option 2 were associated with level B1; those corresponding to option 3 were associated with level B2; those corresponding to option 4 were associated with level C1; and those corresponding to option 5 were associated with level C2. This way, statistical data were generated by calculating the mean of items and competency areas, and tables with descriptive statistics for each of these parameters were presented, comparing the pre-test and post-test results.

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III. Study Results

En este apartado se reflejan los principales resultados globales que se han obtenido en este estudio. Para comprenderlos debemos leer el epígrafe anterior y considerar los niveles de competencia digital y su forma de interpretar según estos resultados.

In **competency area 1, professional commitment**, participants obtained an overall score of 3.09 points in the pre-test and 3.64 in the post-test. After the training, participants increased their level in this dimension by 0.55 points, as well as the qualitative level of proficiency, from B2.1 to B2.2 (see Table 1).

Table 1.

Average result of competency area 1.

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Ítem 1.1	3,16	B2.1	3,89	B2.2	0,74
Ítem 1.2	3,26	B2.1	3,53	B2.2	0,26
Ítem 1.3	3,58	B2.2	3,84	B2.2	0,26
Ítem 1.4	2,37	B1.1	3,32	B2.1	0,95
Global Average	3,09	B2.1	3,64	B2.2	0,55

Source: own elaboration.

In the pre-test, the item with the lowest score was "1.4. Participate in online training courses," with 2.37 points. However, the item with the highest score was "1.3. Actively develop my digital teaching competence," with 3.58 points. In the post-test, the item with the lowest score was "1.4. Participate in online training courses," with 3.32 points. However, the item with the highest score was "1.1. Systematically use different digital channels to improve communication with students, families, and colleagues. For example: emails, Whatsapp messaging apps, blogs, the school website...", with 3.89 points.

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In **competency area 2, digital resources**, the overall score was 3.44 points in the pre-test and 3.58 in the post-test. Therefore, after the training, participants increased their level in this dimension by 0.14 points, as well as the qualitative level of proficiency, from B2.1 to B2.2 (see Table 2).

Table 2.

Average result of competency area 2.

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Ítem 2.1	3,26	B2.1	3,53	B2.2	0,26
Ítem 2.2	3,79	B2.2	3,74	B2.2	-0,05
Ítem 2.3	3,26	B2.1	3,47	B2.1	0,21
Global Average	3,44	B2.1	3,58	B2.2	0,14

Source: own elaboration.

In the pre-test, items "2.1. Use different websites and search strategies to find and select a wide range of digital resources" and "2.3. Safeguard sensitive content securely. For example: exams, grades, personal data..." stand out with a pre-test score of 3.26 points, being the lowest. However, the item with the highest score was "2.2. Create my own digital resources and modify existing ones to adapt them to my needs as a teacher," with 3.79 points. In the post-test, in this dimension, the item with the lowest score is highlighted, which was "2.3. Safeguard sensitive content securely. For example: exams, grades, personal data..." with 3.47 points. However, the item with the highest score was "2.2. Create my own digital resources and modify existing ones to adapt them to my needs as a teacher," with 3.74 points.

It should be noted, according to the results, that in item 2.2., there has been a setback in digital competency development when comparing pre-test results with post-test results.

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In **competency area 3, digital pedagogy**, the overall score was 3.22 points in the pre-test and 3.66 in the post-test. After the training, participants increased their level by 0.43 points, as well as the qualitative level of proficiency, from B2.1 to B2.2 (see Table 3).

Table 3.

Average result of competency area 3.

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Ítem 3.1	3,74	B2.2	3,89	B2.2	0,16
Ítem 3.2	3,05	B2.1	3,79	B2.2	0,74
Ítem 3.3	3,32	B2.1	3,47	B2.1	0,16
Ítem 3.4	2,79	B1.2	3,47	B2.1	0,68
Global Average	3,22	B2.1	3,66	B2.2	0,43

Source: own elaboration.

In the pre-test, the item with the lowest score stands out, which was "3.4. Use digital technologies to enable students to plan, document, and assess their learning on their own. For example: self-assessment tests, digital portfolios, blogs, forums...", with 2.79 points. However, the item with the highest score was "3.1. Consider carefully how, when, and why to use digital technologies in classes to ensure their added value is explored," with 3.74 points.

In the post-test, there was a tie for the lowest scores between the items "3.3. When my students work in groups or teams, they use digital technologies to acquire and document knowledge" and "3.4. Use digital technologies to enable students to plan, document, and assess their learning on their own. For example: self-assessment tests, digital portfolios, blogs, forums...", both with 3.47 points.

Therefore, the item with the highest score was "3.4. Programming," with 1.67 points, and the item with the highest score was "3.1. Consider carefully how, when, and why to use digital technologies in classes to ensure their added value is explored," with 3.89 points.

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Regarding **competency area 4, assessment and feedback**, the overall score was 3.46 points in the pre-test and 3.82 in the post-test. This reflects that after the training, participants increased their level in this dimension by 0.37 points and from a level of B2.1 to B2.2 (see Table 4).

Table 4.

Average result of competency area 4.

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Ítem 4.1	2,89	B1,2	3,16	B2,1	0,26
Ítem 4.2	2,58	B1,2	3,11	B2,1	0,53
Ítem 4.3	2,58	B1,2	2,89	B1.2	0,32
Global Average	3,46	B2.1	3,82	B2.2	0,37

Source: own elaboration.

In the pre-test, the scores were equal for the items "4.2. Analyze all available data to identify the student who needs additional support" and "4.3. Use digital technologies to provide effective feedback," both scoring 2.58 points. The item that received the highest rating was "4.1. Use digital assessment strategies to monitor student progress," with 2.89 points.

In the post-test, the item with the lowest score was "4.3. Use digital technologies to provide effective feedback," with 2.89 points. However, the item with the highest score was "4.1. Use digital assessment strategies to monitor student progress," with 3.16 points.

Regarding **competency area 5, students training**, participants obtained an overall score of 3.24 points in the pre-test and 3.59 in the post-test. These data indicate that after the training, participants increased their level in this dimension by 0.36 points, as well as the qualitative level of proficiency, from B2.1 to B2.2 (see Table 5).

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Table 5.

Average result of competency area 5.

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Ítem 5.1	3,58	B2.2	3,79	B2.2	0,21
Ítem 5.2	3,11	B2.1	3,74	B2.2	0,63
Ítem 5.3	3,68	B2.2	3,95	B2.2	0,26
Global Average	3,24	B2.1	3,59	B2.2	0,36

Source: own elaboration.

In the pre-test, the item with the lowest score was "5.2. Use digital technologies to offer students personalized learning opportunities. For example: assign different digital tasks to meet individual learning needs, consider preferences and interests...", with 3.11 points, while the item with the highest score was "5.3. Use digital technologies for students to actively participate in classes," with 3.68 points.

In the post-test, the item with the lowest score was "5.2. Use digital technologies to offer students personalized learning opportunities. For example: assign different digital tasks to meet individual learning needs, consider preferences and interests...", with 3.74 points, and the item with the highest score was "5.3. Use digital technologies for students to actively participate in classes," with 3.95 points.

Finally, in competency area dimension 6, facilitating students' digital competence, participants obtained an overall score of 2.80 points in the pre-test and 3.22 in the post-test. These data indicate that after the training, participants increased their level in this dimension by 0.42 points, as well as the qualitative level of proficiency, from B1.2 to B2.1 (see Table 6).

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Table 6.

Average result of competency area 6.

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Ítem 6.1	2,68	B1.2	3,16	B2.1	0,47
Ítem 6.2	2,79	B1.2	3,05	B2.1	0,26
Ítem 6.3	2,63	B1.2	3,16	B2.1	0,53
Ítem 6.4	2,95	B1.2	3,32	B2.1	0,37
Ítem 6.5	2,95	B1.2	3,42	B2.1	0,47
Global Average	2,80	B1.2	3,22	B2.1	0,42

Source: own elaboration.

In the pre-test, the item with the lowest score was "6.3. Propose tasks that require students to create digital content. For example: videos, audios, photos, presentations, blogs, wikis...", with 2.63 points, while two items reported the highest scores: "6.4. Teach students to behave safely and responsibly online" and "6.5. Encourage students to use digital technologies creatively to solve specific problems. For example, overcome obstacles or challenges emerging in their learning process," both scoring 2.95 points.

In the post-test, the item with the lowest score was "6.2. Propose tasks that require students to use digital means to communicate and collaborate with each other or with an external audience," with 3.05 points, and the item with the highest score was "6.5. Encourage students to use digital technologies creatively to solve specific problems. For example, overcome obstacles or challenges emerging in their learning process," with 3.42 points.

Considering the 22 items that make up the pre-test and post-test questionnaire as a reference, it can be observed that the item with the lowest score in the pre-test was "1.4. Participate in online training courses," with 2.37 points, compared to the item with the highest score, which was "2.2. Create my own digital resources and modify existing ones to adapt them to my needs as a teacher," with 3.79 points.

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However, considering the post-test data, the item with the lowest score was "4.3. Use digital technologies to provide effective feedback," with 2.89 points, compared to the item with the highest score, which was "5.3. Use digital technologies for students to actively participate in classes," with 3.95 points.

As **overall results of the study**, it can be noted that participants obtained an overall score of 2.58 points in the pre-test and 3.42 in the post-test. Therefore, after the training, participants increased their overall level by 0.84 points, as well as the qualitative level of proficiency, from B1.2 to B2.1 (see Table 7).

Table 7.

Assessment of Digital Competence Level According to Study Participants' Perspectives

	Pre-test Results		Post-test Results		Difference
	Mean	Level	Mean	Level	
Global Average	2,58	B1.2	3,42	B2.1	0,84

Source: own elaboration.

These results indicate that hypothesis 1 is accepted, while the remaining hypotheses (2, 3, 4, 5, and 6) are rejected, following the analysis of the data and the generation of scientific results from the study.

IV. Conclusions

Contemporary educational trends call for a re-evaluation of traditional learning paradigms and a concerted focus on the effective integration of digital competences within educational institutions. Consequently, there is an imminent need to redefine our perspectives in response to the pervasive presence of technology in education and the numerous benefits it brings, such as catering to diverse learning styles and paces, empowering students, and facilitating synchronous/asynchronous communication between students and teachers (Gavilanes et al., 2019).

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To accomplish this, it is essential to establish the necessary conditions within organisational and methodological spheres that enable teachers to enhance their digital competences and seamlessly incorporate them into their teaching practice. Furthermore, Sarmiento and Cadena (2017) underscore the importance of updating and equipping educators with the skills required to reinforce the teaching and learning process, considering the rapid advancement in the use of information and communication technologies (ICT) witnessed over the past decade.

The importance of digital competences in future teaching professionals and the crucial role of public policies in this challenge are crucial aspects to consider in the current context of education. In an increasingly digitalized and technologically advanced world, it is essential for teachers to be prepared and competent in the use of digital tools to provide quality education and prepare students to face the challenges of the 21st century.

Primarily, it is important to highlight the relevance of digital competences in future teaching professionals. Technological advancements are rapidly transforming the way we teach and learn. Teachers need to be familiar with digital technologies and know how to effectively integrate them into their pedagogical practices. Digital competences go beyond technical knowledge and encompass skills such as the ability to search, evaluate, and use online information, promote collaboration and communication through digital platforms, and foster creativity and critical thinking using digital tools.

The development of digital competences in future teaching professionals is essential to ensure that students acquire the necessary skills to fully participate in a digital society. Today's students are immersed in a digital environment from an early age, and it is the responsibility of teachers to prepare them to be responsible and competent digital citizens. Additionally, digital competences are also key to fostering student motivation and engagement, as the use of technology in the classroom can make learning more interactive, relevant, and appealing.

In this regard, public policies play a crucial role in driving digital competences in future teaching professionals. Governments and educational institutions must establish clear frameworks and guidelines that promote the integration

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of technology in education and support teacher training in digital competences. This involves providing resources and professional development opportunities for teachers to acquire the necessary skills and stay updated in an ever-evolving digital environment.

Public policies should also address the digital divide and ensure that all teachers have access to the necessary digital tools and resources. The lack of infrastructure and connectivity can be a barrier to the development of digital competences in some contexts, so it is essential to invest in the necessary infrastructure and provide equitable access to technology.

Furthermore, public policies should foster research and collaboration among educational institutions, teachers, and researchers in the field of digital competences. This allows for the identification of best practices and the development of effective strategies for teacher training and the development of digital competences.

Throughout the project, the lack of skills and abilities in digital competences among the study participants was corroborated, which invites us to continue researching with other variables and samples, focusing on digital literacy for teachers and students.

Finally, it is necessary to emphasise the importance of digital competences in the educational field. From this perspective, as expert professionals, we have the task of contributing to technological and digital training processes and strategies, thereby serving as a support path to optimise the acquisition of digital competences among students, educators, and society as a whole.

In conclusion, digital competences are essential in future teaching professionals and play a fundamental role in 21st-century education. Public policies have the responsibility to promote and support the development of these competences by providing resources, training, opportunities, and an enabling environment for their growth. By doing so, we can ensure that teachers are well-prepared to navigate the digital environment and provide quality education that prepares students for the challenges and opportunities of the digital era.

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CHAPTER 2. THE CHALLENGE OF INITIAL TEACHER EDUCATION: POTENTIALITIES AND WEAKNESSES

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I. Introduction

In recent times, several governments and institutions have tried to adapt their educational systems to the digital society, a society that, along with the economy, has been rapidly transforming and becoming more technological (European Commission, 2020; Ministry of Economy and Digital Transition, 2020). Thus, there has been a clear concern in teacher training policies in Western countries and organisations that seek to support these policies, focusing not only on the development of digital skills through initial and continuing teacher training, but also through financial support for the implementation of technological equipment (Meirinhos & Osório, 2019; Silva et al., 2019).

Since it is urgent to prepare quality teachers for 21st century schools (Flores, 2015; Quadros-Flores, 2016), the development of digital skills of educators and teachers in initial training has been promoted, with a focus on skills development in the areas of technical and pedagogical knowledge, innovative active methodologies in context (Raposo-Rivas et al., 2020), and the construction of experiential knowledge that promotes innovative practices (Muñoz et al., 2015), in which ICT play a key role in the practices of teachers in training. Thus, all these profession-specific skills (Lucas &

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Moreira, 2018) are fundamental not only for changing educational practices, but also for renewing the professional teaching identity in the digital age (Quadros-Flores & Raposo-Rivas, 2017). However, despite the effort that has been made in initial training for methodological renewal and integration of educational technologies, particularly in Supervised Educational Practice, in which they intervene in real contexts, there are difficulties that inhibit the "disruptive innovation for being a challenge of radical transformation of traditional cultures" (Quadros-Flores & Ramos, 2016, p. 196). In this sense, the authors show that innovation must be gradual since it involves schools whose renewal is slow. On the other hand, the lack of technological equipment hinders educational practices, namely the development of renewed and creative practices, since the school equipment in schools still falls short of the expectations of the needs of the schools of the future (ANPRI, 2018; Graça et al., 2020; Quadros-Flores, 2016).

In this sense, this article is part of the IFITIC Project which aims to rethink educational practice with ICT in the initial training of future teachers, in order to promote methodological renewal in pre-school education and in the 1st and 2nd cycles of basic education. This is an exploratory and interpretative study in which, based on the analysis of the public internship reports of students in initial teacher training in the Master's Degree in Pre-school Education and Teaching in the 1st cycle of Basic Education, we seek to understand, from the analysis of the technological resources used and methodological options, the potentialities and weaknesses found by future teachers in the practices of the 1st cycle of Basic Education.

II. Theoretical framework

Initial teacher education is a crucial stage in the training of future teachers, the first stage in the construction of professional knowledge, representations, skills and emotions of what it means to be a teacher. It is a moment of socialisation in the educational reality, relevant in the construction of knowledge, the know-how of being and being where professional ethics is relevant in the self-perception of oneself and of others. Avoiding the weaknesses mentioned by Mesquita (2010)

> Some weaknesses found in initial training are presented, namely: a routinization of strategies in the preparation of teachers, which inhibits the development of educational innovation; an inability to adapt to changes operated by society and the school, in recent years; out-of-step training practices that do not find strategies that enable the articulation between

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> theory and practice; and difficulty of articulation with schools, where future teachers will work (p. 6)[1]

Initial teacher training is currently seeking to revitalise educational practices by integrating new, more active and innovative methodologies, based on varied resources that integrate the digital and analogy. Future teachers are stimulated to find integrative methodologies, supported by clear objectives that aim at the reconstruction of structural educational models. This integration implies the development of the teacher's digital, pedagogical and technical skills, in a permanent update, since "the Digital Competence of educators and teachers is increasingly called for the renewal of educational practices, so it is urgent to prepare future teachers for a school integrated in the digital society" (Graça et al., 2021, p. 27). Note that, according to Costa (2019), digital technologies can diversify pedagogical experiences in various domains and areas of knowledge, in different pretexts with different objectives and theoretical perceptions. In this sense, they can induce innovation in teaching and learning processes allowing achievements that were not possible before their existence. Conceiving digital technologies as cognitive tools, which enhance students' complex thinking (Jonassen, 2007), gives students the opportunity to build their knowledge through their use.

There are theoretical frameworks that seek to guide teachers and educators in the development of their digital skills. We highlight the DigCompEdu (Redecker, 2017) framework, which aims to support pedagogical practices that enhance student participation in the teaching and learning process using digital technologies. It is inspired by the progression model in Bloom's taxonomy and contemplates several levels of digital empowerment progression: (A1) - awareness; (A2) - exploration; (B1) - integration; (B2) - specialisation; (C1) - leadership and (C2) - innovation. The MINERVA project (1996-2004) and the Technological Plan for Education (2007) were important in the past, as they constituted a set of measures of ICT integration in Portuguese schools by the Government with the purpose of modernising schools preparing them for the demands of the technological age. Currently, the Ministry of Education's Program for Digital Empowerment of Schools (2020) stands out, whose main objective is to develop teachers' digital competencies with a view to a better efficiency in the pedagogical integration of ICT transversally in the different curricular areas.

Integrating technology in the educational process also requires a transformation of the teaching and learning paradigm itself, conceiving new

[1] quotation in Portuguese and translated into English.

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ways of learning how to learn, which implies changes at the methodological and curricular levels. At the curricular level, it has undergone changes being rethought considering the Digital Society strengthening digital skills as proposed by Prensky (2001) and Santaella (2010). Thus, a curriculum connected to digital technologies is proposed, in which networks of knowledge sharing, innovations and transformations are built, materialised in a web curriculum (Almeida & Silva, 2016). In this context, the curricular documents in force that guide the teaching and learning process, the Essential Learning (EA) (Direção-Geral da Educação, 2018) and the Profile of Students Leaving Compulsory Schooling (PASEO) (Oliveira-Martins et al., 2017), show that ICT emerges as an area of cross-curricular integration in the 1st cycle of basic education, in which all components of the curriculum are developed. Its insertion refers to the development of digital skills aimed at the exercise of active, critical and responsible citizenship, in which, throughout the four years, students develop: i) critical, reflected and responsible attitudes in the use of digital technologies, environments and services; ii) skills of research and analysis of online information; iii) ability to communicate appropriately, using digital media and resources; iv) creativity, through the exploration of ideas and the development of computational thinking with a view to the production of digital artefacts (p. 2).

There are also curricular guidelines for the use of ICT, which organise four important work domains: i) Digital Citizenship; ii) Investigate and Research; iii) Communicate and Collaborate; iv) Create and Innovate. Thus, it is important that curricular documents guiding educational practices are aligned with a digital curriculum, the web curriculum. For Valderrama-Hernández et al., (2021), cyber-citizenship currently encourages collective thinking through the interconnection of analyses of the concrete reality that surrounds us and makes it possible to work in networks, thus promoting learning diversity.

This integration implies methodological changes, given that it is necessary to rethink new, more active learning environments, and in this sense, active methodologies have assumed an important role in educational settings (Moran, 2018). It is intended, therefore, that students build their knowledge in a participatory, autonomous and responsible way, developing digital skills, enabling a transdisciplinary and entrepreneurial vision of knowledge. There are several active learning methodologies: Gamification, Problems based learning (PBL), Project based learning (PBL), Peer Instruction, Flipped Classroom, Just-in-Time Teaching, Design thinking, Rotation by stations, and others (Silva, 2020).

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This implies, in turn, that it is also reflected in the organisation of the classroom space itself, since the physical environment of school buildings influences the performance of students and teachers (Guardino & Fullerton, 2010). It is therefore crucial, to reflectively rethink the integration of technology in these environments. However, the motivation of teachers and educators is influenced by digital devices in the school context (Quadros-Flores et al., 2013), which is sometimes reflected as an inhibiting factor in the pedagogical integration of ICT in educational practices (Graça et al., 2021). Therefore, when we refer to Supervised Teaching Practice (STP) operationalized in real contexts, we must consider not only the didactic and pedagogical knowledge of future teachers, but also the devices available for educational practice.

We believe that the construction of renewed educational practices lies essentially in the combination of the use of digital technologies with active learning methodologies, and therefore we guide future teachers in initial training in this direction because we believe in their potential, but we recognize that there are weaknesses in the integration of this combination in the students' practices. In order to better manage and empower the ICT training and promote strategies that integrate digital technology, using their internship reports we seek to understand: What digital devices do the students in initial teacher training have available in their educational contexts?; What weaknesses do the students in initial teacher training find in their practice?; What kind of activities, strategies, methodologies do they carry out in the schools where their internship takes place? This is why we want to better understand this reality to better act in the initial training of teachers.

III. Methodological options of the study

This article is part of the IFITIC Project, which aims to rethink educational practice with ICT in the initial training of future teachers to promote methodological renewal in preschool education and in the 1st and 2nd cycles of basic education. In this sense, it focuses on students in the initial teacher training of the Master's Degree in Pre-school Education and Teaching in the 1st cycle of Basic Education, in which we will try to analyse public internship reports, paying attention to the educational practices developed in the 1st cycle of Basic Education.

This is an exploratory and interpretative study, based on a quantitative analysis, supported by internship reports that are public from the year 2022. Only the reports that were in the ESE repository, and therefore of public

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access, were considered. The writing of this internship report is a mandatory requirement for the conception of a master's degree. It includes all the educational practice developed in the internship context in the two valences for which the master's degree qualifies. In this sense, we tried to answer the following questions by analysing them: i) What digital devices do students in initial teacher training have available in their educational contexts? ii) What kind of activities, strategies, methodologies do they carry out in the schools where their internship takes place; and iii) What weaknesses do students in initial teacher training find in their practice? We analysed 21 internship reports, of which 20 were written by female and 1 by male students.

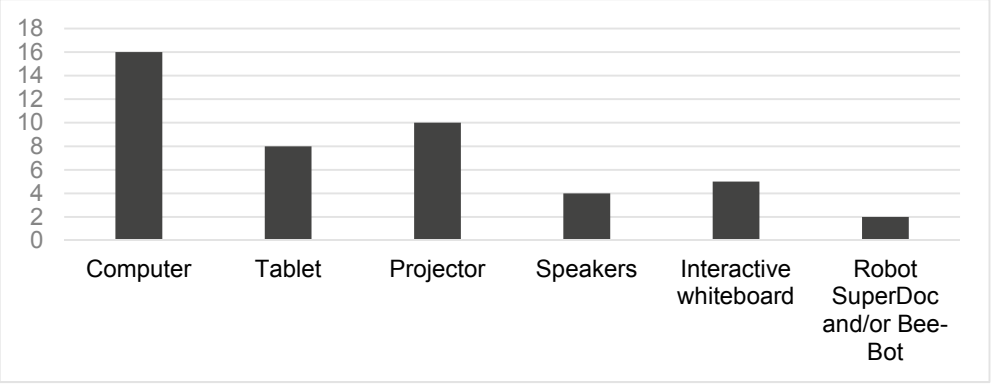
IV. Analysis (and discussion) of the results

4.1. Digital devices available in the internship centres

Knowing the digital devices available in the internship contexts reflects the possibilities offered for the construction of more innovative educational practices, in which ICT is a means for the development of their students' learning. In this sense, it is important for us to know this same reality, trying to understand what technological park is available in the educational contexts (Figure 1).

Figure 1.

Digital devices available in the internship contexts



Source: own elaboration.

The results in Figure 1 show that the learning centres have basic technological equipment and resources, namely "computer", "projector", "tablet" and "speakers". Not all educational centres have speakers and interactive whiteboards, and the resources for Initiation to Programming in

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1st Basic School, namely the *Super-Doc* and/or *Bee-Bot* robots, are scarce, with only 9.5% of the educational contexts having these resources.

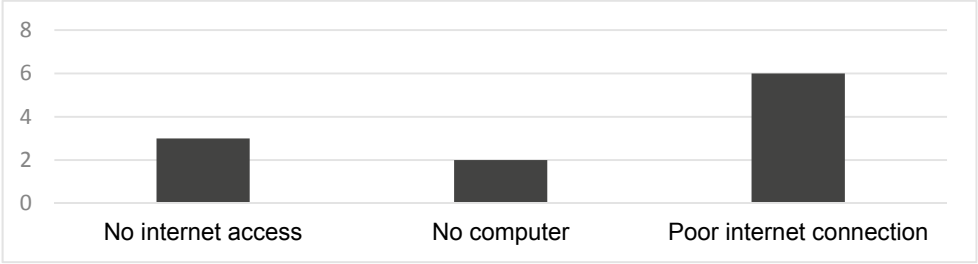
Regarding this small number of robots, it is possible that its justification comes from the recent inclusion of Robotics and Computational Thinking in Education in Portugal. The programme "Programming in the first cycle of Basic Education" (Figueiredo & Torres, 2015) was created in 2015, in which guidelines on computational thinking were created, which later included suggestions from Educational Robotics. In 2018, Educational Robotics and Computational Thinking became part of the official documents of the Directorate-General for Education and its use began to be inherent in teaching practices.

It is understood that, for renewed and innovative practices to be possible, with a technological dimension that accompanies the creative and methodological pedagogical processes, it is necessary that the contexts are also renewed and accompany this growth, with the integration of various technological elements that allow for the diversification and creation of new practices. Thus, we conclude that the digital devices available in the internship centres are still part of a construction process (Ramos et al. 2011), a process that possibly requires investment not only in the insertion of new digital devices, but also in training for their use in new practices.

Knowing that the digital devices available in educational settings influence the educational practices of future teachers as they are sometimes factors that inhibit the construction of more innovative practices (Graça et al., 2020), we wanted to understand the weaknesses pointed out by students in initial teacher training (Figure 2).

Figure 2.

Weaknesses/difficulties pointed out by students in initial teacher training in their educational practice.



Source: own elaboration.

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Despite the effort that has been felt in the context of the modernisation of schools - by the Parque Escolar programme (Portal Parque Escolar, n.d.), or even the Action Plan for Digital Transition in Portugal (Ministry of Economy and Digital Transition, 2020), with its various projects, including the Education project called Digital School that is currently in force - the difficulty in accessing the Internet is one of the major factors identified by students, which hinder the implementation of innovative practices with the involvement of ICTs in their internship contexts.

Thus, being considered as a desirable outcome, according to the latest edition of the State of Education (CNE, 2021), "the proportion of schools with access to internet and computers for teaching purposes" (p. 28), in which the equipment with internet connection has increased, it was deduced that most students presented as the greatest weakness for the development of their innovative practices the "poor internet connection", followed by the option of "no internet access", which implied, in some moments of the students' practices, the adequacy (through the use of their personal mobile networks) and/or adaptation of the digital tools already prepared.

The lack of a computer in the classroom was also identified as a weakness, which compelled students to use their own personal equipment to boost their practices. Thus, it was found that students in initial training often, together with their Higher Education institution and the IFITIC project that provides surfaces for request (integrated in InEd, Centre for Research & Innovation in Education), ensure the necessary resources and tools to carry out educational practices with ICTs.

In addition, when they found some ICT equipment, they reported that it did not work or was not enough for the purpose of the lesson, which implies that there is a need for greater investment in the maintenance of the technological park available in educational settings, namely the operation of the internet (either through a network or via WiFi) and the available computers. Therefore, it is assumed the perspective advocated by Graça et al. (2021) when they indicate that there are inhibitors to the use of ICT, namely the technological resources and equipment of the educational centres of training.

4.2. Digital technologies and active methodologies used in their educational practices

We also wanted to understand which digital technologies students in initial teacher education used in their internship context, since they reflect the pedagogical intentionality underlying the action. To this end, we used a word

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cloud that shows, through their internship reports, the digital technologies most used by students (Figure 3). In the word cloud, the size of the words is directly proportional to their frequency in the text.

Figure 3.

Word cloud regarding the digital technologies most used by students in initial teacher training.

Source: own elaboration using the WordArt digital platform.

In fact, identifying the digital technologies used by students in initial teacher training enables us to understand the underlying pedagogical intentions. In this sense, "Padlet" was the tool most used by students in their practices. This tool allows for the creation of interactive murals that enhance the interaction between the teacher and the student, through the exchange of ideas, activities and materials (Silva & Lima, 2018).

The following words stand out: "Bee-bot", a robot used for the development of computational thinking and spatial orientation, through programming language; the digital platform "Wordwall", aimed at assessment and gamification, which leads to the development of skills such as logical reasoning, autonomy, concentration and dexterity (Jesus & Mota, 2021; Sales et al., 2022). Likewise, the word "Voki" is highlighted, which shows that students integrate avatars into their practices, thus increasing the motivation to complete the proposed tasks (Quadros-Flores et al., 2018).

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Also, in the scope of the development of computational thinking and programming language, "Scratch" is mentioned. With the same visual stain, the digital platforms "Canva" and "QRCode" are highlighted, for content creation; "Zoom", a technological tool that enables communication between individuals.

In terms of gamification and assessment, students also mention "Kahoot", "Plickers", "Quizizz", "Socrative" as platforms that allow the application of the knowledge built throughout the pedagogical activities, the self-regulation given by the immediate feedback, involving the student in the process of self and hetero-assessment and the teacher as a professional who intervenes immediately in the class or in the group of students who have obtained unsatisfactory results. There are also digital platforms which allow the construction of idea maps about the subjects to be studied, such as "Mentimeter", "Bubblu.us" and "Vengage". There is also a tendency for students to use Office tools, such as "PowerPoint" and "Word", as well as digital platforms that allow the viewing of video content, such as "Youtube" and "Edpuzzle". Also mentioned are digital publishing platforms such as "Flipsnack" and even "Storyjumper", as well as "Lucidchart" for creating online diagrams.

Thus, future teachers integrate different digital technologies in their educational practice, which reflect different pedagogical intentions that favour the teaching and learning process of students. They are aligned with an open education in a humanistic paradigm where the student knows and knows how to do, involving himself in the learning process where he builds knowledge and representations about reality in connection with peers and others. Thus, it should be noted that, currently, teacher training institutions attend to the development of the future teacher's digital skills, aligned with the guidelines recommended by the theoretical frameworks that prepare them for the challenges of a digital school (Graça et al., 2021), stimulating the mobilisation of this knowledge in a pedagogical and articulating range of knowledge in the understanding of reality.

Thus, being aware that the integration of digital technologies in the teaching and learning process should be combined with active and participatory methodologies, we sought to understand which methodologies were used by students in initial teacher training (Figure 4). It should be noted that, throughout their educational practices, students used several methodologies.

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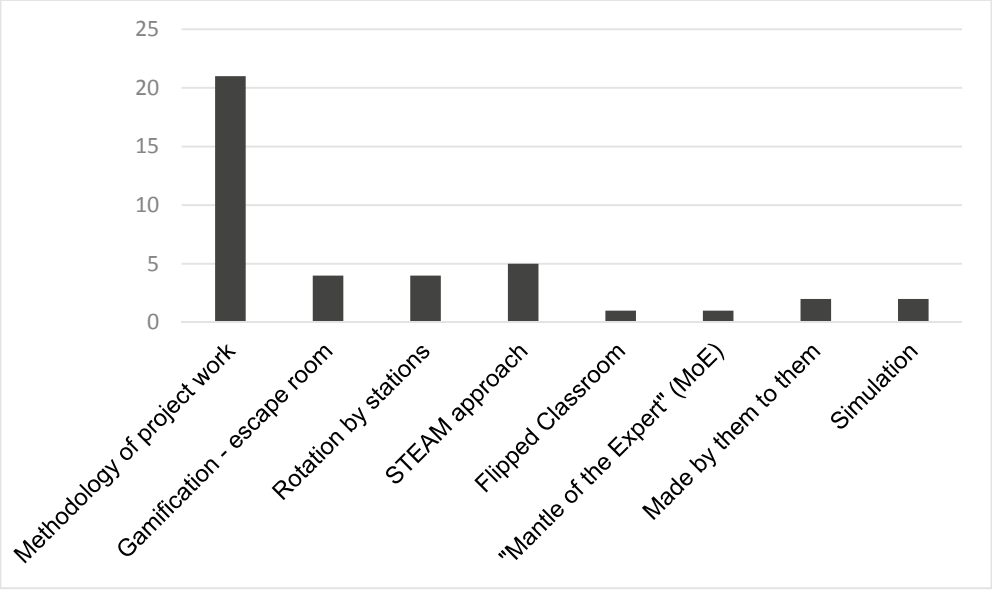
Figure 4.

Active methodologies used by students in initial teacher training in their educational practices.



Source: own elaboration.

The predominance of the use of the "Project Work Methodology" in the educational practices of the students in initial teacher training is remarkable (100%) since it allows breaking away from the traditional stigma and favours the development of inter and transdisciplinarity that promotes divergent thinking and a multidimensionality that diversifies the processes and promotes autonomy and significant learning. With 23.8%, the "STEAM approach" stands out for its potential to integrate knowledge from Arts, Sciences, Technology, Engineering and Mathematics to solve real problems, preparing students for societal challenges. Problem-based learning is a new way of learning that gives meaning to learning and promotes the development of logical

and cognitive reasoning that favours students' complex thinking (Jonassen, 2007) and the development of personal skills applicable in students' lives.

The methodologies "Gamification - escape room" and "Rotation by stations", with 19%, are also mobilised for the pedagogical activities of students in

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initial training with their students, since the first one allows "developing cognitive, emotional and social skills, stimulating creativity, critical thinking and decision-making and leadership skills in solving tasks, problems and puzzles that are related to the content to be addressed during the class" (Pereira et al., 2020, p. 1009). The second, favours the involvement and motivation of students because they assume an active role in their learning (Alvarenga Souza et al., 2020).

The chart also shows, with a less significant percentage of 9.5%, the active methodologies "Simulation" and "Made by them to them", since the first creates motivation in the student to learn and act in accordance with the learning that the teacher intends, and the second combines three important steps in the learning process: the Flipped Classroom in the "prepare-do" and Storytelling in the "make-tell" that together form the triad "see-reflect-evaluate" (Quadros-Flores et al., 2019). And therefore, enhancers of active learning of students.

Thus, it can be concluded that students in initial teacher training seek to integrate in their educational practices, active methodologies in different moments of the lesson, offering opportunities for students to construct their knowledge in an active, participatory and autonomous way (Moran, 2018).

V. Conclusions

Understanding the realities of the educational contexts of students in initial teacher training, as well as their methodological and technological options, make it possible to identify potentialities and weaknesses in their educational practices. The implementation of renewed and innovative practices requires the necessary conditions for the pedagogical integration of digital technologies, in which the educational contexts must accompany this renewal and growth of technological equipment in an effective way, namely regarding their quality, quantity and diversification. It was found that, given the lack of resources found in cooperating schools, future teachers, thanks to their personal equipment and support from the higher education institution, found opportunities in educational spaces, assuming a teaching profile capable of solving problems and designing and developing practices that respond to the current curriculum. Furthermore, it was found that students in initial teacher training recognise the potential of the various digital tools and are able to assign different pedagogical intentions in a constant articulation with the guiding documents of educational practice.

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Training teachers in line with a changing paradigm requires a strong vision from higher institutions, an aligned collaboration with cooperating schools and a willingness to be a teacher in the 21st century by future teachers.

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CHAPTER 3. THE POTENTIAL OF EDUCATIONAL ROBOTICS FOR LEARNING ABOUT THE REFUGEE THEME: VIEWS FROM THE STUDENTS AND THE TRAINEE TEACHER

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I. Introduction

New challenges are posed to education, which require the development of skills and abilities to search, select and understand information, which is vast and varied, and sometimes contradictory. It implies, therefore, critical thinking that enables a better reading of the world and societal reality, enhancing students' digital literacy (Pereira, 2011). In this sense, as presented by Quadros-Flores et al. (2013), ICTs, in addition to involving students, can put them at the centre of learning, so that they actively participate, understand what they are learning and work collaboratively, since they favour a "constructivist approach in which collaborative learning is privileged" (Cardoso, 2013, p. 296).

This study is part of an intervention project - "Being human in the world: in a flight towards equality", developed with a 3rd grade class, within the scope of the Supervised Teaching Practice (STP) curricular unit of the Master's Degree in Pre-school Education and Primary School Teaching. It arose from the students' interest and curiosity in the current social reality of the war in Ukraine and Russia and the inequalities faced by women in Afghanistan. The educational practices were developed in four interventions, organised in learning units and were based on the Project Work methodology. Three main objectives were pursued: i) to make students aware of cultural diversity, stimulating their capacity for analysis and reflection, developing critical and reflective thinking; ii) to explore the issue of refugees, enhancing situations of empathy, in which students put themselves in the other's shoes,

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understanding their motivations and difficulties; iii) to encourage active and responsible citizenship, fostering attitudes of solidarity and intervention in the community.

It was also intended to develop knowledge, skills, attitudes and values present in the Profile of Students Leaving Compulsory Schooling (PASEO), namely critical thinking, autonomy, collaborative work, communication, valuing respect for diversity, human dignity, solidarity, rejecting discrimination (Oliveira-Martins et al., 2017). It is in this sense that the learning unit - "Everything is lost in a second and Man sees himself opening up the world" - appears. In this chapter, we will focus on one of the activities framed within this unit, which sought to develop the programming language using educational robotics. Thus, tangible object programming skills were enhanced, supported by an Action-Research Methodology with the purpose of improving practices throughout the interventions. After all, "the awareness of what a teacher actually does, and of his/her representations, is the starting point for his/her involvement as a teacher in change" (Altet, 2000, p. 33). Thus, it is necessary to recreate educational practices (Quadros-Flores & Raposo-Rivas, 2017), which necessarily require digitally competent teachers prepared for the challenges of a digital school (Graça et al., 2021).

II. The integration of educational robotics in learning

The construction of theories on education has essentially pointed towards a view of man in the world, to achieve an integrating view of it (Estrela, 2006), leading to a more humanistic education. As argued by Morin (1999), it is impossible to break down and segregate the real problems affecting society. However, it is common to observe practices where the moments dedicated to each domain are clearly distinguishable, which, according to the author, is insufficient, being a problem to be solved in education. If we aim at an education with a humanistic basis, not promoting the articulation of knowledge is, therefore, unthinkable. It is necessary, then, to look at the curricular areas in an integrating and transdisciplinary way, mobilising this knowledge for practical life. Morin (1999) indicates that the professional should focus on global problems, contextualising them in educational practice, promoting learning opportunities that enable the challenges imposed by these problems to be met. To this end, it is necessary to promote skills to act for a better world, given the growing environment of uncertainty in which students live, and help them understand others, in an education for citizenship and humanity to be able to respond to this world of permanent change (Oliveira-Martins et al., 2017). In this sense, education does not exclusively serve the curricular knowledge, but transcends to useful skills for

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life in society and values that sustain humanity. This idea is also recommended in the Decree-Law No. 240/2001 of August 30, which approves the profile of the educator and teacher. It highlights the need to use transversal knowledge in an integrated way, combining the civic and formative function of the teaching work and enhancing the integral development of children. In this sense, a transdisciplinary learning is envisaged, in which the focus is on understanding reality, admitting its complexity, and exploring themes and problems that go beyond the "traditional academic disciplines" (Beane, 2003, p. 108).

One of the fundamental pillars of the group's Educational Project is based on the idea that school should contribute to the construction of knowledge and important values for a fairer society, centred on the person and on action on the world. The development of social issues, such as refugees, occupied, in this sense, a relevant place in the project. Increasingly, students find themselves in a globalised world, confronted with issues such as war and the consequent disrespect for human rights, which they need, according to the Essential Learning (Direção-Geral da Educação, 2018), to actively recognize, being an issue that ends up causing contact between peoples, a new reality for students, it was important for them to recognize and value "the diversity of ethnicities and cultures existing in their community" (p. 5).

In this context, it is important to rethink the curriculum in the light of this Digital Society, which is characterised as complex, controversial and challenging, in which new digital skills are demanded from young people, who are considered digital natives (Prensky, 2001; Santaella, 2010). Although the motivation factor in using ICT is recognized, some teachers lack the necessary conditions to feel encouraged to use them, namely regarding the training and resources available in the school context (Quadros-Flores et al., 2013). Sometimes this is reflected as an inhibiting factor to the pedagogical integration of ICT in educational practices (Graça et al., 2021). Thus, despite recognizing their potentialities, many teachers end up demotivated by the conditions available in the educational settings where they teach. However, using ICT is not synonymous with creating a productive classroom (Cardoso, 2013), nor should these be seen as an end, but as a means to achieve a certain goal. Therefore, it is essential that the teacher integrates them pedagogically in their practice, in a constructivist way, as a cognitive tool (Jonassen, 2007), aiming at the development of students' critical and reflective thinking on the subject under study, in a perspective of research, collection, selection and analysis of information, execution of consolidation exercises or production of their creations.

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The potential is even greater for learning when these are combined with participatory methodologies, such as the Project Work methodology, where, according to Mateus (2011), learning is built around real and relevant problems, which make sense to students because they relate to the society in which they live. Because, according to the same author, Project Work allows a transdisciplinary approach to knowledge, being flexible and adjusted to the priorities of the group, it was considered appropriate to adopt this methodology. Thus, as argued by Abrantes et al. (2002), opportunities for personal and social development of students were promoted.

This pedagogical use of ICT implied that the student also developed her digital literacy, because "the Digital Competence of educators and teachers is increasingly called for the renewal of educational practices, so it is urgent to prepare future teachers for a school integrated in the digital society" (Graça et al., 2021, p. 27). Therefore, the development of the master's student's digital skills is highlighted as a relevant point to be considered for the construction of more renewed practices. In this sense, we highlight the use of Educational Robotics, through the development of programming language skills. In addition to motivating students, this resource promotes problem-solving skills and allows for the creation of environments that encourage the mobilisation of students' knowledge in different areas (Ribeiro et al., 2011). Moreover, its use, particularly the use of simulations, enhances the students' attention span, especially of those who have more difficulties, and promotes their autonomy (López-Belmonte et al., 2021). However, by promoting problem situations in which students have to resort to programming language to solve them, we will be creating opportunities that promote transversal skills that are essential in 21st century education, such as collaboration among students, since they are committed to overcoming challenges as a team, and creative thinking, which is necessary to find resolution strategies (Romero, 2016). In this specific case, a robot, the *Bee-Bot*, was used to program a route through the simple control of its arrows located on the "top" part of the robot. Thus, notions of spatial orientation were developed in the area of Mathematics (forward, backward, right turn, left turn, and pause), as well as in other areas of knowledge. In this way, students are able to see problems not as situations to be avoided, but opportunities to learn.

Finally, as mentioned by Quadros-Flores and Raposo-Rivas (2017), today, in the digital age, it is imperative to encounter new dynamics and strategies, but change with meaning is required. Now, the production of knowledge for this to occur takes place if the professional acts as an investigator, who seeks to assign meanings to what he or she is doing (Cortesão & Stoer, 1997). In

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this sense, the Action-Research Methodology is a challenge to educational professionals in order to improve educational practices (Coutinho et al., 2009), as it stimulates an analytical, critical and interventive attitude towards the problems detected, allowing for the construction of knowledge that supports "practices oriented towards social transformation" (Cortesão & Stoer, 1997, p. 27). Thus, the potential of ICT integration in the teaching and learning process leads to new challenges and opportunities for students and teachers. However, we must know how to mobilise them, according to the intended pedagogical intentionality, and combine them with more participatory methodologies that lead to the formation of critical, participatory, and autonomous students in society.

III. Research methodology and data collection techniques of the study

The Action-Research Methodology was used throughout the educational practices, since it offers an analytical, critical and interventive stance towards what is observed and the problems detected, since the researcher needs to know the context in which he or she will act. To achieve this goal, participant observation proves to be adequate (Simões & Sapeta, 2018). However, Action Research only exists when it acts to transform. Thus, as a result of this immersion in the context, relevant techniques and resources were used for data collection: i) observation guides, which could be completed through a systematic and intentional look at the reality; ii) logbooks, which were used to record the observations, accompanied by field notes, photographic and video records; iii) interviews with the cooperating teachers, supported by an interview script, with the purpose of obtaining more in-depth information about the educational context. We believe, therefore, that this is the basic pillar of the intentionality of the training of educational professionals with a view to change, transformation and renewal of educational situations. Therefore, throughout the practice, an approach to this methodology took place, since it places teacher training in constructivist models, sustained by research that is reflexive and interactive.

3.1. Participants of the study

In this study, 21 students from the 3rd grade (8-9 years old) of a school grouping in Porto participated. Curious and participatory, although not very autonomous, they showed difficulties in concentration and in working in groups, as well as heterogeneity in learning pace. The educational context in which this class was inserted had some technological limitations, namely the internet, which was unstable and conditioned the activities. In addition, they had the possibility of using a mobile projector, tablets and laptops, as

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well as robots, provided by the grouping, although their quantity did not allow for individual use. Finally, as for the dissemination of the intervention project, besides being done by the other classes of the school, family members and teaching and non-teaching staff, the 11th grade students and the Portuguese Red Cross also participated.

IV. Practical experience / Empirical experience

Throughout the SEP, the project "To be human in the world: in a flight towards equality" was built, with the objectives already mentioned above, focusing on the premise that the school contributes to the construction of knowledge and values, important for a fairer society, centred on the person, human dignity, and action on the world as a common good to be preserved. It included 4 pedagogical interventions, as shown in table 1.

Table 1.

Sessions and initiatives of the developed intervention project.

Intervention sessions	Main goals:
1st Session: "Malala: to want is to be able!"	• Learn about Malala's life; • Gain awareness that not all children live in the same circumstances.
2nd Session: "The diversity that U(n)E us: a journey from Portugal to the world"	• Recognize and value cultural and ethnic diversity: - differences between Portugal and some countries of the European Union; - shared values in the European Union;

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3ª Session: "Everything is lost in a second and Man sees himself opening up the world"	• Know the rights of children; • Recognize cases of disrespect of rights; • Understand the refugee problematic (Who are they? Where do they come from? With what motivations? What difficulties do they face? How can we help?)
4ª Session: "We Are Inspiring"	• Understand the meanings of inspire; • Meet inspiring people, namely understand the work developed by the Red Cross; • To know stories of refugees; • Recognize oneself as being able to inspire to improve the world.

Source: own elaboration.

In these intervention sessions digital technologies were integrated into active and participatory learning methodologies, according to the intended pedagogical intentionality. However, in this article, we will only focus on one of the lessons developed in the 3rd session, in which educational robotics was used.

The learning unit had the problem question "What do we face when we lose some rights?". It aimed to raise students' awareness about Children's Rights, showing some cases of disrespect for them. It included 3 lessons; however, we will focus on the lesson, also accompanied by other digital technologies, in which the use of educational robotics was privileged (Table 2). The presented drawing allows us to contextualise the emergence of the activity and reveals how the contents can be approached in a transdisciplinary way, in a coherent and non-segregating process, to develop a pertinent theme - refugees.

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Table 2.

3rd lesson of the learning unit - use of educational robotics.

Design of the learning environment	Goals	Resources
• Prior knowledge survey: distinction between migrant and refugee; • Dialogue on cases of disrespect of fundamental rights and analysis, with the game "Was I forced?", of situations potentially promoting forced migration; • Reading and analyzing the literary work A Long Journey by Daniel Hernandez Chambers (2018) and identifying the difficulties faced by refugees; • Location on the world map of countries in which some refugees originate, with determination, conversion and comparison of distances.	• Develop critical thinking, autonomy, collaborative work, communication, adoption of an interventional and solidary posture; • Recognize their rights and cases of disrespect for them; • Understand and distinguish the definitions of migrant and refugee; • Recognize causes and difficulties associated with forced migration; • Relate the migration of animals to the migration of human beings; • Listening to read, reading and interpreting a literary work; • Recognize points on the globe through ICT; • Collect, read, and analyse numerical data (understanding the concepts of maximum, minimum, and range); • Recognize the meter and the kilometer as units of measurement and perform conversions.	• Computer; • Projector; • Speakers; • Image "I had to give up this right"; • Digital Platform Wordwall: https://wordwall.net/pt/resource/25012480/fui-for%c3%a7ado • Literary work *A long journey* by Daniel H. Chambers (2018) • Guide for interpreting the work Analysis script "How long is the journey?" • Digital Platform *GoogleEarth*.
• Simulation of the route of a refugee from one of the previously mentioned countries to Portugal, using the programming language with a *Bee-Bot*: - each student receives a sheet for recording the different schedules performed; - in a small group, the student discusses the programming he will do to the *Bee-Bot* on the grid mat;	• Develop critical thinking, autonomy, collaborative work, communication, adoption of an interventive and solidary posture; • Orient themselves in space, describing positions and routes/itineraries; •Recognize the potential of robotics (the Bee-Bot); Understand and mobilize the programming language for the realization of a route.	• *Bee-Bot* • Checkered carpet with obstacles/difficulties refugees face in reaching their destination • Schedules log sheet

Source: own elaboration.

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Throughout the learning unit, students recognized the importance of health and family rights, and when discussing cases where rights were not guaranteed, students shared their prior knowledge of the words "migrant" and "refugee" using the digital platform *Wordwall*. Its use, as a cognitive tool (Jonassen, 2007), aimed to create a map of ideas about the theme, thus enhancing the students' ideas and leading to greater motivation. Starting from this analysis of initial ideas, we proceeded to read and analyse the work *A Long Journey* by Daniel Hernandez Chambers (2018), accompanied by interpretation questions, with the aim of recognizing war as a reason for forced migration, understanding the difficulties faced by refugees on the journey and the conditions under which they arrived in the destination country. Thus, on the one hand, the development of reading and interpretation skills was intended, within the scope of Portuguese, in the domains of Literacy Education and Reading. On the other hand, the study of the environment, with the identification of a social problem and the recognition of cases of disrespect for the fundamental rights of human beings, permanently present in the exploration of the problem, and which were articulated with the area of Mathematics.

Building on the exploration of the work, the students were asked, "If a refugee were to come here, would they face such a long journey? How far away from us will the countries from which the refugees come be?". To try to answer the questions, at an early stage, the students made estimates. Then, they confronted their idea with the measurement of the distances between the municipality where the school was located and some of the countries from which more refugees were arriving, through *GoogleEarth*, since this digital platform allowed the visualisation of a three-dimensional image of the globe, which allowed the location of these countries and the subsequent determination of their distance to Portugal. In this sense, and as mentioned in the Mathematics AE, students should be able to establish connections between the same mathematical ideas, namely using technology, reading, interpreting and discussing data, such as measures or even reading and interpreting maps and aerial views (Direção-Geral da Educação, 2021). Thus, it was proposed to students the determination of these distances using the platform tools, to, at a later stage, perform conversions between units of measurement, developing, also, skills in reading numbers.

Therefore, for a better understanding of the subject under study and with the purpose of developing mathematical skills of spatial orientation and programming language of tangible objects, an activity was built using educational robotics, in which students were challenged through a *Bee-Bot* available at the institution to simulate the journeys of refugees. As Delors et

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al. (1996) state, technology, when well used, is a motivational factor for the student to develop learning. In particular, the Initiation to Programming is important, as referred to by the Directorate General of Education (2016), so that, from an early age, students "create habits of using technologies in an appropriate and constructive way" (p. 3). Thus, in small groups, the students, using the programming language, programmed the robot to perform a route, avoiding obstacles and simulating the refugees' journey from their country of origin to Portugal. While one group programmed the robot on the squared mat, built by the trainee teacher, the others had to record that same programming in the guide script that included a grid for the students to fill in the starting and ending points and the obstacles. In other words, all the students recorded the program carried out by each of the groups. Thus, the collaboration of the student was required to solve a problem, a method that, according to Lebrun (2002), favours learning and for which technologies can be put to use.

IV. Results

Next, we will focus on the effects of the use of educational robotics from two perspectives: the students' perspective, using observation notes (NO) and students' interventions throughout the activity (A); and the trainee teacher's perspective, through her observation notes (NO) and her reflective narrative (NR).

4.1. Effects of using educational robotics from the students' point of view

The educational robotics activity proved to be, from the beginning, motivating and stimulating for students, since its use was not common in the classroom, which aroused interest and curiosity. Moreover, the very handling of the robot by the students also increased their enthusiasm and willingness to explore, which was noticeable in the students' interventions: *"Shall we all move?"* (A2) or *"I want to try it!"* (A1). In addition to the enthusiasm visible on the students' faces, the activity gained even more relevance because it offered the possibility of the students being the builders of their own knowledge (Moran, 2018), which contributed to the promotion of the development of essential skills, such as persistence, autonomy, and concentration, which were previously presented as difficulties evidenced by the class.

The students were attentive, involved and, with interest in listening to the indications, they strove to understand and successfully perform the proposed challenges, in a spirit of collaboration in which critical thinking (Oliveira-

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Martins, et al., 2017) was stimulated in order to find solutions to the problem at hand, the route of the refugee (Figure 1).

Figure 1.

Students' programming language development through educational robotics.

Source: own elaboration.

By observing the images, the students mobilised in their speech the lessons learned about the problem, namely the difficulties that each image represented. A moment was created in which everyone was prepared to put themselves in the other's place, a practice of empathy promoted throughout the project, and which culminated with its dissemination. Fingers crossed to cross their fingers or hands together, raising them to the sky, were gestures shared by some students during the activity, which showed their involvement and desire to see their work successfully completed. One of the aspects observed was that students, including those who were not in the small group manipulating the *Bee-Bot* at the moment, *"clapped their hands after the completion of a route, which showed the team spirit and collaboration, and not competition, that was being built"* (NO). The happiness for understanding and overcoming the challenges and their inherent gestures should also be mentioned, since gestures also provide us with great information about

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students' learning, as Malaguzzi argues, when he states that children have 100 languages, multiple ways of communicating, and speech is as informative as gestures or movements (Lino, 2013). Therefore, it is essential that the professional recognizes these multiple languages and gives children the opportunity to express themselves (Souza & Veronesi, 2019).

However, the emerging problems arising from the implementation of the activity should not be ignored, since their analysis is essential to give meaning to the practices and seek to improve them. Despite the involvement and the spirit of "positive confusion" noticed, some difficulties were detected on the part of the students, namely difficulties in the capacity of abstraction, not being able to schematize in the script the path that was being executed by the group with the *Bee-Bot*, namely in the use of the programming language itself with arrows. Despite the fact that they were attending Initiation to Programming, where they explored these practices and concepts, some of them still showed doubts in using the terms "a quarter turn left/right" and, therefore, mathematical knowledge of location and orientation in space, present in Mathematics AEs (Direção-Geral da Educação, 2021), essential for programming. Thus, each group's time was extended, and the others could not follow the work of their colleagues, filling out the record sheet. Therefore, it was necessary to extend the activity, making adaptations. Based on the assumption that everyone has the right to learn, although with different learning paces, it was our intention that the class would be following all the steps of the activity, which was not happening. It was essential, therefore, to help them understand these aspects. Thus, it was decided to stop and, as a class group, discuss how they should perform the programming, challenging them, with examples, to translate the movements that the arrows represented, in which the student had the opportunity to take an active posture. Only when it was verified that everyone had understood, the programming of the courses proceeded.

This evolution of the students' understanding of the programming language was reflected in the following moments of the class, in some of the students who had not managed to understand and assimilate the programming language. We highlight the example of student A1, who, like her classmates, was determined to answer the challenges autonomously. Student S., concentrated and in a good mood, stood up and positioned herself according to the *Bee-Bot's* orientation in order to program the movements and register the programming language with arrows: "*The robot is like this, I have to stay like this [positioning himself with the same orientation as the robot]. Now, if he has to go over there [pointing to the left], I have to go a quarter turn to the...left! The arrow is like this, then. [Turns to the record sheet to draw a left-*

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facing arrow]" (NO). The point to note in this observation is that, without cues, *"the student was able, by finding her own strategy, to understand the programming and movements and respond to the challenges"* (NO). It was also observed, in general in the class, progress in the ability to program the next morning, since the students showed they knew the steps of the process and were able to correct themselves and correct the other, arguing the reason for a certain thought when programming and, thus, avoiding mistakes. This ability to share and collaborate meets, as Moran (2018) argues, active learning, in which the student is at the centre of the learning, as intended: *"One group agreed that everyone would take turns programming the robot's movements. A2, announced that he was going to program the Bee-Bot to move forward three squares. His friend A7., from the same group, called his attention before the robot was programmed, arguing that it should only move forward two squares. Otherwise, the Bee-Bot would run into an obstacle. The group agreed and R. recounted the squares, recognizing that he had made a mistake in counting."* (NO). The students understood what they were doing, and the errors that appeared were the result of small distractions. The adult intervention was less and less necessary because the students were able to collaborate, creating a climate of sharing and learning among them. Thus, it was observed the impact that the problematization of situations causes in students, who engage in understanding and solving them, developing a critical sense that allows them to build knowledge (Freire, 2006).

4.2. Effects of using educational robotics from the trainee teacher's point of view

The reflection carried out by the trainee teacher, central to the training process that highlights the awareness of herself and her limits in the context of pedagogical and technological knowledge, can be divided into three moments: lesson planning, reflection on action in the face of emerging problems, and post-action.

In this sense, knowing the potential of technology, particularly educational robotics, implementing an activity in which the trainee teacher would use it was a challenge, since she did not know many digital tools, had never planned an activity of this type and, furthermore, when observing the educational context, she noticed some inhibition in the use of ICT by the teacher, which was conditioned by the context, which had an unstable internet network. These initial difficulties were highlighted in the reflective narrative of the trainee teacher but were not inhibiting reasons for the construction of innovative practices: *"In addition to the fact that there were*

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not enough tablets to allow individual use, Internet access had many faults. If, sometimes, with only one device connected to the network, there were connection cuts, it was certain that, by connecting several devices, the internet failed in all. However, it was argued that these conditions should not inhibit the use of ICT, and that it was necessary to seek solutions that would make it viable. Trying to use them pedagogically and believing in their potential contributed to the fact that, with the support of the institutional supervisor, as a future professional, I learned about new platforms and gained skill in using them. That said, in the presented activity, we intended to involve ICT, putting the student at the centre of learning and enhancing sharing in the promotion of collaborative work." (NR).

The trainee teacher overcame the fear of the unknown, sought to build knowledge about the use of the resource in students' learning, finding solutions that allowed the educational practice to be carried out, and did not allow these aspects to be inhibiting factors of the pedagogical integration of ICT in educational practices (Graça et al., 2021). In addition, we did not intend to conceive the use of technology as an end in itself, but as a constructivist cognitive tool, framed in contextualised activities, articulated with the areas of knowledge and integrated within the scope of the project that was being developed.

Time management was also an important point that the trainee teacher mentioned in her reflection, since she chose not to comply with the planning time, which was previously defined, for the sake of student learning and the difficulties that were being noticed, because, as Cardoso (2013) states, a proactive teacher "never gives up on making the student understand and reach the objectives" and "her mission will not stop until she finds a way, possibly differentiated, for each student to grasp the lesson" (p. 65). It was also one of the aspects reflected in his NR: *"Reflecting on the observations made in the action, it is important to highlight the relevant role assumed by the flexible nature of the implementation of the planning, particularly in terms of time management. I planned 50 minutes for the programming activity with the Bee-Bot. Analysing the observation notes, considering what I knew about the class, namely the pace of work, and taking into account the difficulties detected in the students, one can understand that this prediction was, from the start, a mistake. As it turned out, it was necessary to continue the activity in the afternoon and the next morning. This continuity was given in order to guarantee the same opportunities to all students, that is, so that everyone could manipulate the robot and program its path, under the same conditions. It should be understood, however, that the problem does not lie in the delay,*

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but in the reasons that caused it. Reflecting on them is important to detect the need to make adjustments and improve the teacher's practices." (NR).

With the necessary support, the difficulties were prevented from becoming blockages for the students (Perraudeau, 2006). As the group indicated the next step that the Bee-Bot would do, they were asked to select the arrow that should be placed on the board present in the script provided, recording the programming and supporting the students who, with more difficulties, could not follow the rhythm with which the indications appeared. Thus, it was ensured that the class recorded all the routes presented and discussed during the class.

Finally, given that a teacher must assume his or her responsibilities in the students' results and reflect on the appropriateness of the strategies he or she used and how he or she can help them recover (Cardoso, 2013), it should be noted that, although the activity had allowed for the development of learning in students, as well as a growing motivation in the use of educational robotics, the implementation of another strategy would have been beneficial for the implementation of the activities, envisaging a possible alternative: *"It would have been more advantageous to provide a moment of dialogue, in which programming knowledge was previously developed, before moving on to the application with the Bee-Bot. Certainly, this strategy would have made the moment more meaningful from the beginning, avoiding some of the problems mentioned. Despite the emerging problems, to which we tried to respond, reflecting after the action, we made a positive balance, considering the favourable environment for learning that I managed to create and the progress that the students showed. The motivation caused by the resource, a potentiality shared by ICT, was verified, putting the students in front of new challenges."* (NR).

Recognizing weaknesses, potentialities, envisioning new ways of learning and teaching is important for teachers' professional development, since professional growth, as Graça et al. (2019) point out, is materialised by experiences in real contexts, in a joint and interactive dialogue with the agents involved, with a view to renewing educational practices.

V. Conclusions

Pedagogical practice "is the opportunity to learn to transform disciplinary knowledge into professional knowledge capable of grounding and guiding the daily teaching action" (Formosinho & Niza, 2009, p. 130). It is important, therefore, to highlight the learnings built throughout the educational practice

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presented. Integrating educational robotics as a cognitive tool that aims to develop students' complex thinking (Jonassen, 2007) in the project allowed the association of abstract thoughts related to programming with something tangible and with a purpose, enabling students to understand the usefulness of technology (Direção-Geral da Educação, 2016).

Moreover, it should be noted that one of the main difficulties recognized in children was related to the ability to maintain concentration and perform activities independently. In this sense, the use of educational robotics provided an answer, as it was a motivating and appealing strategy. On the one hand, it promoted involvement and enthusiasm since students remained interested and engaged in performing the programming in a relaxed and fun environment. On the other hand, their persistence in solving the problem, even with the difficulties already mentioned, did not make them give up until they overcame the challenge. This, because they were intrinsically determined to succeed, and not because they felt external and oppressive pressures, wanting to learn how to accomplish the various possible routes. Moreover, there was room for error since their mistakes were not pointed out with judgement. They recognized them themselves, could observe their consequences through the *Bee-Bot's* movements, and in the next moment discuss and try again, developing the expected skills (collaboration, communication, abstraction, spatial orientation, use of the programming language), in an active and innovative learning process.

It also enhanced communication and collaboration among children since they had difficulties in managing behaviours and distributing tasks when performing collaborative work dynamics. Within the small group, the students, without directions, discussed and agreed on the distribution of tasks, organising themselves in order to give opportunity to all elements to actively participate and manipulate the *Bee-Bot*. The spirit of mutual help, enhanced by the dynamics created with the use of this digital resource, remained thus evident, being a reason for satisfaction.

Finally, I would like to highlight the importance of the Action-Research Methodology, which conducts a continuous process of observation, planning, action, and reflection, practises necessary for the constant search for progress and answers to the problems faced. Through it, it was possible to transform insecurities and doubts into achievements and learning. The factors that could inhibit the use of digital technologies in the classroom became aspects that the trainee teacher saw as potentialities for that group of children, as she tried to be a "reflective and critical professional who accesses the profession to reconstruct herself" (Graça et al., 2019, p. 132).

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In that sense, in future educational practices, it would be interesting, on the one hand, to make the changes identified as pertinent during the after-action reflection and, on the other hand, to understand what the potentialities of the frequent use of this type of resources by the students are in their learning and in their own behaviour. To what extent were their potentialities and the achievements that were recognized promoted by the novelty factor? What other observations and progress would be recognized as the integration of educational robotics in the classroom became more common? These are questions that future reflective practices might answer.

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CHAPTER 4. COLLABORATIVE METHODOLOGY AND ONLINE DEBATE. AN EXPERIENCE WITH SCIENTIFIC READING WORKSHOPS IN HIGHER EDUCATION

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I. Introduction

In recent decades, the university has undergone a continuous reconceptualization to provide effective responses to society's personal, social, and cultural demands through a review not only of its pedagogical approach and its mission, but also of its future (Villa & Villa, 2007), in accordance with the idea of student social development. From this perspective, learning constitutes a social activity resulting from the interaction between people, means, and environments (Esteban & Gutiérrez, 2017). In this sense, university teachers have the double challenge of, on the one hand, providing students with academic and intellectual training in the different areas of knowledge and, on the other hand, developing skills that allow them to function successfully in new educational and professional environments.

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As professors at the Faculty of Education of the University of La Laguna (Spain), we pay special attention to reading and analysing complex scientific texts. These lectures aim to promote critical thinking and understanding of Education from an analytical and social point of view. However, the teaching staff faces the challenge of covering an ambitious training program in eighteen teaching hours distributed over a four-month period, one hour a week during the first ten weeks and two hours a week for the last four weeks. Unfortunately, this is a limited time that does not allow us to go deeply into the analysis and debate of the selected texts. In addition, the class groups are made up of many students, which prevents everyone from having the opportunity to actively participate in the learning process.

To overcome these difficulties, it was decided to implement an active learning methodology, through the online debate technique, to encourage reading and analysis of texts and promote reflection and exchange among students beyond the face-to-face class schedule.

The objective that we set ourselves was to transform the reading workshop that is taught exclusively in person in the Sociology of Education subject in the first year of the Degree in Primary Education, at the University of La Laguna (Spain), into an experience that includes virtual work, so that the students, in addition to the weekly face-to-face hour, could debate the readings through digital debate spaces created for each reading. To do this, we selected and configured two tools: a classic debate forum supported in the virtual classroom and one of the Padlet platform tools configured to support the debate.

In this work, the research objective is to evaluate the effectiveness of the proposed methodology, taking into account the commitment of the students, their perception and the academic performance achieved. To address this objective, we set the following specific objectives:

- Analyse the commitment of the students with the methodology.
- Analyse the perception of students regarding the aspects involved in the dynamics, with special attention to collaboration.
- Determine the effect on the level of learning achieved.

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II. Theoretical approaches and literature review. Debate as an active and collaborative learning strategy

Since the second UNESCO World Conference on Higher Education (HE) held in 2009, HE has undergone substantial changes, which have created new opportunities and at the same time generated new challenges. Among the changes promoted are the responsibility of institutions to present and evaluate a plurality of points of view and participate with society in public debates on complex issues and, at the same time, include digital technologies in the teaching and learning process to support the democratisation of knowledge and favour the creation of networks and collaboration (UNESCO 2022).

Consequently, we are facing a change in basic assumptions in favour of a curriculum that responds to the challenges of a Knowledge Society, where the most important thing is learning to learn, in accordance with the idea of student social development (Villa & Villa, 2007). In this context, the collaborative and active paradigm (focused on learning) is one of the most effective methodologies to promote social learning (Bernardo et al., 2017). In fact, through the strategies used in collaborative learning, education among peers is promoted, while the acquisition of academic knowledge, the development of motivation and self-esteem, among others, are encouraged (Guerra et al., 2019). For Mayorga and Madrid (2010), the collaborative model, as a representation of the activity of teaching as an interactive practice and as a shared function, is based on the common experience of the teaching-learning process, designed and developed as a space for involvement and co-reflection between educators and students, and students among themselves. Today we know that cooperative learning groups develop a positive interdependence between the components of the group as soon as there is a clear individual responsibility and a shared leadership in the achievement of the task. "Cooperative learning, therefore, implies a form of active learning, with multiple recognized benefits, both educational and social" (Guerra et al., 2019, p. 272, own translation).

In the theoretical framework of active learning and responding to the integrated conception of the curriculum, the debate is presented as a methodological strategy that breaks with the centrality of the subjects in the curriculum, since the important thing is to debate the problematic topic, which is resolved with contributions from various disciplines (Vásquez et al., 2017, p.136). Debating in relation to learned content means activating and promoting attentive reflection that establishes a connection between the society in which we live and the university (Rodríguez, 2012). In this sense,

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the use of debate as an active and cooperative learning tool facilitates not only the cognitive and individual development of students but also the learning of transversal skills, for example, knowing how to communicate, dialogue, take the initiative, interact or empathise (Guzmán, 2008), so that we are influencing the integral formation of the student (Rodríguez, 2012).

However, the teaching plan and its curricular requirements do not always provide enough space and time for students to participate in an in-depth debate. At the same time, a passive attitude of the students towards group discussion is often observed (Vásquez et al., 2017), as well as a difficulty in assuming a critical position and arguing personal opinions, thus weakening the process of exchange and creation of knowledge. Faced with these difficulties, virtual learning environments can represent an ideal alternative to favour and promote debate, especially considering the time available to students to reflect and argue asynchronously in the virtual space for debate and, in addition, these environments offer the possibility of presenting opinions in a more reasoned way, which can also favour the participation of those students who present communication difficulties in a group of people.

III. Practical experience / Empirical experience

The research has been conducted during the first quarter of the 2022/2023 academic year, in the first year of the Degree in Primary Education at the University of La Laguna. The enrolled students come from the entire archipelago of the Canary Islands (Spain), the number of first-year students is 260, and is distributed in three groups, of almost one hundred students each, which are subdivided again for practical classes of the subjects. The didactic methodology that we present was conducted during the practical classes of the Sociology of Education subject, specifically in five groups of practices: PA101 (20 students), PA102 (27 students), PA201 (30 students) and PA202 (28 students), which means a total of 105 students. Of the total number of students, three did not want to participate in the study and another 8 did not complete the surveys, so the information collected refers to a total of 92 students.

Groups P101 (20 students) and P201 (25 students), 45 students in total, followed a didactic strategy based on a classic forum created in the virtual classroom, supported by an installation based on the Moodle platform. Groups P102 (24 students) and P202 (23 students), 47 students in total, used the Padlet tool for their debate dynamics. Of the total number of students, 56 are women and 36 are men. The ages of the students range from 17 to 45 years, with an average age of 19.4.

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To conduct this research we have used a mixed methods approach, since as many authors point out, the use of mixed methods designs is an excellent alternative to address research topics in the educational field (Tellez & Martinez-Guirao, 2015). The selection of a mixed method has been shown to be a powerful methodological option to triangulate the theory with the information obtained (Aguilar & Barroso, 2015). Specifically, in this research we have applied both qualitative techniques, participant observation, and quantitative techniques, the survey.

3.1. The didactic methodology

The methodological proposal consists of an adaptation of the principles of collaborative work under a face-to-face and virtual class dynamic, that is, it would be a proposal under the blended-learning paradigm. The students have a weekly face-to-face session, and we open spaces for online debate to extend the work and debate throughout the week. The teacher does not participate until the debate is closed, at which time he collects the synthesis of the answers that the students have made and comments on them, opening a last space for discussion this time in face-to-face class.

The detailed procedure is as follows: one week before the first face-to-face session, the reading and a guide to questions are delivered. In this case, an article by the professors Antonia Olmos Alcaraz and María Rubio Gómez was selected entitled "Corporality of the «good student»: representations of gender, «race», ethnicity and social class in the Spanish school" (Olmos & Rubio, 2013, own translation). Students must read it prior to the first face-to-face session. During the face-to-face session, teams are formed with approximately five students, the work procedure is explained, and the sharing within each team about reading begins. However, time is insufficient to agree on the answers and to delve into the texts. At the end of the class, a random group is chosen that will be the one that will have to publish their answers. At the end of the session, virtually, the selected team has twenty-four hours to publish their answers. Once published, the rest of the students have five days to enter the Forum or Padlet as appropriate and comment, if they consider it necessary, in a constructive manner the answers provided, this means indicating improvements to the approach or wording of the same, opening discussion until a consensus is reached. These contributions are not individual but working team, so the teams must meet through the means they choose to agree on their responses. The day before the second face-to-face class, the initially selected team will review the comments on their proposals and make a final publication with a synthesis of the responses provided by their peers.

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Finally, during the second face-to-face session, the teacher reviews the definitive answers and opens a last space for discussion about reading with the whole class. At the end of the class, a survey was given to evaluate the methodology, the discussion tool, and the level of learning achieved by each student.

IV. Results

The main objective of this research is to evaluate the effectiveness of the proposed methodology. A methodology that aims to extend the debates from the face-to-face class to the virtual one as a complementary activity, not mandatory, therefore, its success is intricately linked to the predisposition of the students to participate. Consequently, the first section is dedicated to analysing the degree of commitment of the students. In the second section, we address the analysis of the students' perception of various aspects of the experience, focusing especially on organisational issues and their vision of collaboration through the proposed virtual environments. Finally, in the last section, we analyse the influence of the methodology on the learning achieved by the students.

4.1. Students' commitment to the methodology

Commitment to the methodology can be checked by measuring and evaluating the amount of time spent preparing the activity and the degree of participation in the online discussion. In this sense, we asked the students how much time they had spent sharing the answers with their work team. This previous exchange is important because one of the teams initiates the debate and a consensus is required on the answers to be published, in addition, subsequent participation must also be agreed upon by the teams, since what we want is not an individual participation but a consensual and collaborative, where the different teams contribute their analyses to the discussion. The results obtained are as follows: 6.7% of the students indicate that they did not meet, 33.7% met between 15' and 30', 41% between 31' and 60', and, finally, 10.6% of the students met for more than an hour. Consequently, in this first phase, 6.7% of the students were left out of work, while 93.3% started the activity properly. These are percentages of participation that teachers consider normal and comparable to other activities.

The other aspect to consider is the degree of participation in the online debate, in fact the second part of the activity required a follow-up of the publications. Consequently, we asked the students the number of accesses

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to the debate during the period that it was active. As reflected in Table 1, differentiating by tool, we observe that most of the students accessed it between two and three times throughout the virtual debate period, in addition there are no significant changes between the two proposed tools.

Table 1.

Degree of participation in the online debate according to the debate tool.

	Percentage of students by number of accesses					
Number of accesses	0	1	2	3	4	5 or more
Forum	11,11%	24,44%	26,67%	28,89%	4,44%	4,44%
Padlet	6,38%	23,40%	48,90%	17,02%	4,26%	0,00%
Total	8,70%	23,90%	38,00%	22,83%	4,35%	2,17%

Source: own elaboration.

As can be seen, there are no significant differences according to the type of tool, so we analyse the information in an aggregate manner, observing that 8.7% of the students indicate that they did not enter the debate spaces, 23.9% only once, 38% twice, 22.83% three times, 4.35% four times, and 2.17% more than five times. Teachers consider that an optimal commitment for the debate to be fruitful implies following the debate assiduously at least two or more times a week, in which case, according to the teachers, 32.6% did not have a minimum acceptable participation, while 67.4% did pay attention to the debate appropriately.

In short, only 67.4% have been committed to the online debate. A result that warns us of the difficulties that students have to monitor and participate online when it is a non-compulsory activity.

4.2. Students' perception of the methodology and online collaboration

In the following table (Table 2), we analyse the perception of the students on different aspects related to the methodology according to the debate tool. The students valued these aspects according to a Likert scale from 1 to 5, where 3 is the average value.

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Table 2.

Student perceptions of the methodology according to the type of tool used for the online debate.

Items	Forum	Padlet	Variation
I understand the dynamics of the debates	3,72	4,03	0,31
Time available to participate in the dynamic	3,26	3,58	0,32
I would prefer a more individual work methodology	2,23	2,42	0,20
I feel inhibited from participating	2,00	2,14	0,15
I find it difficult to express my ideas in writing	2,04	1,95	0,09
I would prefer a work methodology not mediated by ICT	2,10	2,22	0,12

Source: own elaboration.

Once again, we observe that the variations between the results depending on the type of tool are not significant. Regarding the students' understanding of the proposed dynamics, most of them report that they have understood it, and most of them consider that the time available to participate has been sufficient. In the same way, the majority prefer collaborative and ICT-mediated methodologies over individual work. Finally, only a small percentage show inhibition to participate and express their ideas, which, according to the teachers, implies a greater willingness to debate than what they observe in face-to-face classes, and which may respond to a certain positive predisposition among those students who face-to-face are inhibited. A fact that confirms the results of other studies that indicate that students feel more confident when participating online than in face-to-face classes (Onyema, Deborah, Alsayed, Noorulhasan, & Sanober, 2019; Filippo, Fuks, de Lucena 2009).

Regarding the students' perception of the experience from the point of view of collaboration with their classmates, in the following table (Table 3) we analyse various aspects.

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Table 3.

Student perception of collaboration through the didactic experience.

Items	Forum	Padlet	Variation
The methodology promotes collaboration between the work team	3,73	3,95	0,23
Encourages collaborative learning within the class group	3,63	3,79	0,16
Indicates the level of collaboration within the working team	3,89	3,90	0,01
Indicates the level of collaboration with the class group	3,51	3,98	0,48
Online debate favours your social skills to interact with your peers	3,12	3,31	0,18

Source: own elaboration.

The first observation is that there is no significant difference in the results according to the discussion tool. However, it is relevant as the items: "The methodology promotes collaboration between the work team", "Encourages collaborative learning within the class group", "Indicates the level of collaboration within the working team" and "Indicates the level of collaboration with the class group" present values close to 4 (in a range of 1 to 5). Therefore, these results inform us of a very positive perception of the students regarding the dynamics of collaborative work in online environments.

The only item that presents an average rating is " Online debate favours your social skills to interact with your classmates", which has been scored with 3.12 for students who used the virtual classroom forum and 3.31 among those who used Padlet. When we inquired with the students about this aspect, they told us that these methodologies based on discussion forums are very patterned and activity-oriented, so they are not really an open space for sociability such as personal social networks.

4.3. Academic performance

Undoubtedly, the effectiveness and, therefore, the value of the methodology is reflected in its effects on the learning achieved. In this sense, we asked

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the students if the online debate had been useful to improve their understanding of the text. The average assessment among the students was 3.9 on a scale between 1 and 5, which represents significant support for the methodology.

Finally, at the end of the second session, after closing the explanations, an evaluation test was conducted on the understanding of six key issues that appear in the scientific article analysed. In the following table (Table 4) we summarise the results organised according to the discussion tool used.

Table 4.

Results of the evaluation test according to the type of discussion tool.

Evaluation questions	Percentage of correct answers (Forum)	Percentage of Correct Answers (Padlet)	Variation
P1	33,3%	19,1%	14,2%
P2	42,2%	31,9%	10,3%
P3	82,2%	80,9%	1,4%
P4	75,6%	89,4%	13,8%
P5	66,7%	63,8%	2,8%
P6	68,9%	70,2%	1,3%

Source: own elaboration.

Once again, we observe that there is no clear advantage between the use of the classic forum offered by the virtual classroom and the Padlet tool. However, when the participation of the students in the online debate is observed, we found a significant relationship between the number of accesses during the online debate week and the results in the evaluation test (Table 5).

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Table 5.

Relationship between the number of accesses to the online debate space and results in the evaluation test.

	Percentage of correct answers according to the number of accesses to the online debate		
Evaluation questions	**0 or 1 accesses**	**2 accesses**	**3 or more access**
P1	23,30%	25,70%	30,80%
P2	26,70%	37,10%	50,00%
P3	73,30%	85,70%	88,50%
P4	86,70%	85,70%	76,90%
P5	60,00%	60,00%	80,80%
P6	53,30%	74,30%	84,60%

Source: own elaboration.

As reflected in the table, in five of the six questions that were posed to the students, there is a trend of improvement in the resolution of the questions proportional to the participation in the online debate. Therefore, not only do students point out that the methodology has been a favourable element in improving their comprehension of the text, but there is a clear correlation between the degree of activity in online debate and subsequent performance in assessment tests.

V. Conclusions

From the traditional culture of face-to-face learning, proposing to students a didactic methodology that offers the possibility of extending the collaborative analysis and debate of complex scientific texts beyond the face-to-face class is, without a doubt, a didactic challenge, especially when it is a complementary activity and, therefore, not mandatory. In this sense, the objective of this research was to evaluate the effectiveness of the proposed

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methodology, taking into account the commitment of the students, their perception and the academic performance achieved.

Regarding the commitment of the students, we verified that only 6.7% of the students did not participate at any time, while 67.4% participated optimally in the previous preparation with their work group and during the online debate. It is a positive percentage in numerical terms, but modest from the didactic point of view, which impels us to look for alternatives to incorporate a higher percentage of students to this type of activity.

Regarding the students' perception of the proposed methodology and debate tools, the first observation is that there are no significant distinctions between the tools. On the other hand, the opinion of the students on aspects related to the time required for participation, the understanding of the dynamics, as well as the collaborative and supported approach through technologies has been favourable, with a willingness to participate greater than in face-to-face classes.

In addition, the students consider that this methodology develops and encourages collaboration both in the work team and with the rest of the class. This is an incredibly positive opinion regarding learning that is central in the digital society. However, this type of collaboration with the proposed tools, scheduled and activity-focused, is not considered as a strategy that favours the development of online sociability skills. In fact, these tools are extremely far from the possibilities of interactivity offered by other tools based on social network environments.

The last relevant aspect is the effect of this methodology on academic performance. Again, confirm the little influence between the type of tool used and the learning. However, a relationship is observed between the degree of online participation and the improvement in the results of the evaluation tests, that is, the data indicate that regardless of the debate tool, the greater participation of the student body has an impact on the improvement of the learnings.

In short, we can say that extending the time for analysis and debate of scientific articles, beyond the face-to-face class, has been an opportunity to promote collaborative teamwork, improve understanding of the texts studied and academic results. However, a greater commitment is required on the part of some students to improve participation in these new virtual spaces. Precisely one of the challenges we have as teachers is to encourage student participation in this type of activity.

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Finally, we must not forget that this study was applied to an initial course of the Degree in Primary Education and the results could vary notably in the following courses of the degree. Thus, in the last year, students will have greater knowledge, skills and abilities learned about the didactic tools, so their perception may be different. It could also be interesting to apply this study to other degrees from the Faculty of Education, such as the Master's Degree in Early Childhood Education and the Degree in Pedagogy, in those subjects with hours of practical classes.

It remains to evaluate other online tools adapted to active methodologies in Higher Education that facilitate learning and increase student motivation.

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CHAPTER 5. THE MIND MAP AS A COLLABORATIVE STRATEGY IN HIGHER EDUCATION

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I. Introduction

The improvement of education is intricately linked to the initial and continuous training of tomorrow's teachers. In this sense, university teaching staff have the double challenge of providing academic and intellectual training on the different areas of knowledge, but also developing competencies in future professionals that allow them to function in the new educational and professional environments that are organised online.

Following this perspective, for years at the University of La Laguna (ULL), Spain, all face-to-face teaching has been supported online through a virtual classroom for each subject. However, traditionally it is being used as a repository to organise content, upload work files, and publish events (Area et al., 2018). In this sense, sometimes the full potential of virtual spaces for collaborative work is not used. Currently, we have more tools to collaborate virtually, and it is our aim to analyse their potential as mediators of the teaching-learning processes. This implies a transformation of teaching practice. Therefore, it is necessary to develop active methodologies that give

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prominence to students, as proposed by the European Higher Education Area (EHEA).

Following the quality criteria that guide university education, the ULL approved, more than a year ago in the Governing Council, to adapt its educational system to the so-called Student-Centred Teaching-Learning Model (in Spanish: *Metodología de Enseñanza-aprendizaje Centrada en el Alumno*, MECA). This model is oriented towards project-focused learning, and constructivist learning based on the active search for meaningful experiences connected to reality. The MECA educational model enhances competencies related to knowing how to search for information, creativity, taking advantage of innovation, conducting work collaboratively and developing critical thinking. It is a commitment to active learning away from the format focused on the masterful transmission of knowledge by teachers and repetition by students.

As teachers in different degrees of the Faculty of Education, at the University of La Laguna, we propose practical workshops in the subjects taught, especially relevant are the workshops aimed at reading scientific articles. These workshops are a challenge for students due to the conceptual complexity of the texts, as well as a great opportunity to delve into the understanding of education from a critical and social point of view of the role played by the educational institution. Traditionally, we have used a methodology based on collaborative work groups that discuss the text following a script of questions prepared by the teachers. On this occasion, we set out to incorporate a conceptual analysis tool based on online collaborative mind maps.

The research objective is to analyse the effect on student learning by introducing an online collaborative tool for text comprehension through the construction of mind maps into traditional collaborative work dynamics.

To achieve this general objective, we set ourselves the following specific objectives:

- Analyse students' perception of the use of online collaborative mind maps to work on academic texts.
- Compare the relevant aspects of the traditional collaborative methodology versus a methodology enriched with the development of a mind map.

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- Analyse the degree of learning obtained according to the methodology used.

The results presented refer to students who are in the initial phase of Degree in Primary Education.

II. Theoretical approaches and literature review

2.1. Methodologies based on collaborative learning

The teaching-learning process does not develop individually in isolation, but rather we are mediated by our context, environment, peers, and experts in the field. In this sense, teaching methodologies based on active and participatory methods are spreading, such as collaborative learning, where students are at the centre of the learning experience and teachers become a catalyst in the process. It is a constructivist approach whose main characteristic is the interaction of the subject with its environment. This type of method affects the classroom climate, student self-esteem, academic performance, confidence and motivation for knowledge and social skills such as communication, collaboration, empathy, cooperation, etc.

Collaborative learning is a meaningful learning method that allows students to collaborate with other peers, building knowledge as a group. Its fundamental goal is to work in a group towards a common objective and "the premise is that the mutual commitment of the participants constitutes a decisive factor to develop shared learning" (Leclerc, 2012, as cited in Vaillant and Manso, 2019, p. 21). The most relevant characteristics, according to De Corte (as cited in Vaillant and Manso, 2019, p. 22), would be the following:

- Constructive: learners actively build their knowledge and skills.
- Self-regulated: each subject uses personal strategies to learn.
- Located: learning is understood in its context, not abstracted from it.
- Collaborative: it is an activity that is conducted in relation to others, and not alone.

One of the characteristics of collaborative activities is what is called positive interdependence. It refers to the bonding of a student with the group in such a way that one person cannot achieve success without the rest achieving it. It is a direct interaction, a group interaction in the activity and in the evaluation (Johnson et al., 1994). This supposes a collaboration in the tasks, roles, resources used, etc. (Le et al., 2018).

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2.2. Concept map and mind map: conceptualization and characteristics

The concept map is a tool developed from Ausubel's (1976) learning theory, linked to meaningful learning, which allows information to be organised graphically through the hierarchization of concepts according to their order of importance or inclusiveness. According to Novak and Cañas (2008), we can define it as that hierarchical tool of concepts (perceived regularities or records in events) through labels that determine the relationship between them. It consists of "representing significant relationships between concepts in the form of propositions" consisting of "two or more conceptual terms joined by words to form a semantic unit" (Martínez et al., 2014, p. 53).

Likewise, the mind map is a didactic tool linked to collaborative and meaningful learning that represents, graphically and visually, the components of a conceptual system, in a centralised manner (Codina, 2010). Both the concept map and the mind map have common characteristics and similar objectives, highlighting, as a great difference, that the mind map represents "radiant thinking, where from a central image the main elements of a certain topic branch out through a structure of connected nodes". On the other hand, in the concept map the students must identify "those most relevant ideas or notions of the contents based on their hierarchical organisation and structuring" (Villalustre & Del Moral, 2010, p.18). The objective of the concept map is the "generation, visualisation, structure and taxonomic classification of ideas" or also as "internal help for the study, organisation, decision making and problem solving" (López et al., 2019, p.30).

In the educational field, the concept map and the mind map allow visualising concepts and hierarchical relationships between them (Novak, 2010) as well as facilitating students to learn about the structure of knowledge and the processes of thought construction, metacognition (Martínez et al., 2014). Other authors (Tseng, 2015) point out that mind mapping can be used as a tool in the classroom for teaching critical thinking.

The conceptual map and mind map requires a series of elements that form its structure and constitute the relational diagram (Codina, 2010; Martínez et al., 2014):

- Nodes or concepts: they represent the concepts, facts, objects, qualities, etc., identified with names, adjectives, and pronouns.

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- Linking arcs or words: the existing relationships between the nodes. It refers to verbs, prepositions, conjunctions, adverbs, or any other link between concepts.
- Proposition: is the phrase resulting from the union of two or more concepts and link words (two or more nodes joined by arcs).
- Hypertext links: these are sources of information that enrich the content or help to delve into some aspect. They can be links to web pages, documents, etc.
- Explanatory notes: they are relevant clarifications for the understanding of a specific aspect of the content.
- Cross links between nodes: it is a way to connect ideas and relate concepts.

Although mind and concept maps use this composition, they are also characterised by having a flexible structure, that is, depending on the academic objective, a mind or concept map may or may not have hypertext links.

2.3. The digital multimedia mind map as a collaborative teaching resource.

Education faces one of the challenges of the digital revolution: the inclusion of technology in the teaching-learning processes in an effective way so that it generates a real impact on the educational processes (Rodríguez-García, 2017). This requires a deep reflection of the teaching staff on their teaching practice, their teaching concept and the pedagogical model that best responds to the socio-educational needs of university students. As López Meneses et al. (2019) point out, "a methodological and evaluator-oriented change is necessary to promote the comprehensive training of students through the development of their social, intellectual and technological competencies" (p. 29).

The mind map is considered a learning strategy where the information is more centralised, placing the main topic in the centre and, from it, the concepts and secondary ideas, nexus, hypertext, etc. are projected. (Martínez et al., 2014). It is important that the mind map, as an eminently graphic didactic resource, maintains a visual balance. Its structure and organisation, the spatial distribution, and the format (colours, shapes, size, etc.) must allow the capture of fundamental ideas and the understanding of the content that we want to transmit. In addition, its format through visual and interactive images allows students to remember the content more easily.

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One of the advantages of using multimedia mind maps is that they allow the interaction of its elements, increase readability, and allow it to maintain a visual balance. Some of the tools or options that can be used in this type of map are zooming, displacement, collapsing and expanding nodes or levels selectively, searching for specific information within the map or navigating on it. In addition, it allows us to share it in various formats (text, image, link, etc.) (Codina, 2010).

III. Methodological considerations

The experience was applied to three groups of practical classes of the first year of the Degree in Primary Education at the University of La Laguna during the first quarter of the 2022-23 academic year, in the subject of Sociology of Education. Among the objectives that are intended to be achieved in this subject are, on the one hand, that students know the social functions of the school, its limits, and possibilities in the context of today's society. On the other hand, to promote reflection on issues of a social and ethical nature and, finally, that students can organise and transmit arguments related to their future field of work.

The organisational methodology of the subject during the course follows two lines of action. First, based on expository theoretical classes, where the teacher has a central role although an open dialogue is maintained with the class to promote student participation. Second, based on practical classes that, centred on the MECA educational model, consist of applying active, flexible, and collaborative teaching strategies, focused on reflection, discussion, and debate on basic readings.

3.1. Study group

During the 2022-23 academic year, the Faculty of Education registered an enrolment of 260 students in the first course of the Degree in Primary Education teacher distributed in three groups. The organisation of the subjects of the first course is divided into theoretical classes and practical classes. The research work presented here was planned to address the practical classes of the subject. Thus, these classes divide the students into smaller groups, leaving a total of seven practical groups. Therefore, in each practical class there are about 30 students.

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3.2. Sample

A total of 143 students participated in the study, who agreed to fill in the questionnaire and authorised the treatment of the results. A group of 64 students worked on the text with the mind map collaborative methodology using an online application (Mindmeister 40% and Canva 60%). On the other hand, 79 students followed the traditional collaborative work methodology. As a summary, Table 1 shows the distribution of the students participating in the activity, according to the type of activity in which they participated and gender. The idea of distributing the students in two different strategies addressing the same content was made to enrich and compare both results.

Table 1

Distribution of students according to the methodology used and gender

Methodology	Men	Women	Total
Collaborative work	37	42	79
Collaborative work with mind map	24	40	64
Total	**61**	**82**	**143**

Source: own elaboration.

In the Faculty of Education, as in many of the humanities disciplines, the student body is mostly female. In summary, the sample was represented by 82 women and 61 men, aged between 17 and 38 years. Another characteristic of the sample is that 74% of the students are studying this degree because they have requested it as the first option. Therefore, we could say that it is a student body motivated by their training.

3.3. Activity procedure

The practical classes of this subject consist of analysing readings of articles or book chapters related to one of the topics studied in the theoretical classes. The objective of the practical classes, therefore, is to consolidate the concepts learned in the theoretical classes, reflect experiences in the educational field and generate debate and reflection on the most important topics.

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The students know in advance the article or book chapter that is worked on each week in class. On this occasion, the students had to read an article by the sociologist Aina Tarabini, entitled “What is school for? Sociological reflections in time of global pandemic” (2020).

Thus, the idea is that all students bring the reading done the day the practice begins. It is a prior individual work guided by a list of questions given together with the reading. At the beginning of the practical class, the didactic methodology that will be followed is exposed. In this case, the teachers spend about 10-15 minutes explaining and showing what the methodology consists of (traditional collaborative work or with a mind map). In the next step, each work team shares the main and secondary ideas of the text and creates their product: a document or a mind map, as appropriate.

Each work team had to upload their work to the virtual classroom. The activity closes the following week. In the next class, three proposals are selected that are analysed and debated among the whole class. The teachers close with the final reflections on the most relevant points of the text worked on.

3.3. Research techniques and instruments

To evaluate the didactic experience, the teachers designed two *ad hoc* questionnaires to collect students' responses from an online survey. One of the questionnaires was applied to two groups of practices that used the traditional collaborative work methodology. The other questionnaire was applied to the three groups of practices that made the mind map. Both questionnaires collect the perception of the students about the usefulness of the tool used to understand the text worked on. Both instruments share questions about the socio-demographic profile of the students. In addition, another five questions were included related to the knowledge and use of the methodology, the time dedicated to the elaboration of the task and the usefulness of the tool for understanding the text. A Likert scale was applied to collect the perception of the students about the applied tool. An open question was also included to record advantages and/or disadvantages associated with each methodology. Finally, both questionnaires included questions to check the knowledge achieved about the readings, to verify if there are variations according to the tool used.

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IV. Results

4.1. Students' perception of the use of multimedia collaborative mind maps

In order to know the students' point of view on this methodological innovation based on the use of mind maps, we initially asked if they considered this tool adequate for understanding the proposed text. Following the Likert scale, responses range from 1 (not at all appropriate) to 5 (very appropriate). The results throw a quite favourable vision. All the students considered it adequate (21.4%), quite adequate (35.7%) and very adequate (42.9%).

Although the general opinion is quite favourable, we investigated a little more about the experience of the students with this organisation and analysis tool. The main results are reflected in the following table 2.

Table 2.

Opinion of students on the use of mind maps

	They had not worked with mind maps	Worked with non-digital mind maps	Worked with multimedia collaborative mind maps
Percentage of students	20,30%	18,80%	60,90%
Tool ease of use	3,46	3,75	4,45
Time spent (minutes)	35'	25,2'	25'1

Source: own elaboration.

We observed that 20.3% of the students had not worked with mind maps, 18.8% had used mind maps on paper, and 60.9% had worked with digital multimedia collaborative mind maps.

On the other hand, as reflected in Table 2, the opinion of the students about the ease of the proposed online tool is linked to their experience. The students who had never worked with mind maps rated this aspect with 3.46

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(according to a scale from 1 to 5, with 3 being the average value) and dedicated 35 minutes to preparing the work, while those who had already used mind maps valued 3.75 and dedicated 25.2'. In the case of those who had previous experience with the creation of mind maps with technological tools, they valued the ease of use of the application with a 4.45 and dedicated 25.1' to the elaboration of the map. These data clearly reflect how previous experience, regardless of the type of tool used to design mind maps, represents a 29% reduction in time dedicated to the task. It is also remarkable that those who had worked with mind maps, regardless of the software, dedicated an equivalent time to map design, which indicates that the selected design environment did not pose any added difficulty for those not experienced with these online resources.

4.2. Students' perception of the use of the mind map compared to the traditional collaborative methodology

To check the adequacy of the mind map tool against conventional collaborative work, we asked the students to what degree the methodology had been adequate for understanding the text. The results are reflected in the following table 3.

Table 3.

Adequacy degree according to the methodology used

Methodology	Methodology adequacy degree (1: not adequate at all and 5: very adequate)				
	1	2	3	4	5
Traditional collaborative work	2,53%	7,59%	30,38%	46,84%	12,66%
Collaborative work with mind map	0,00%	0,00%	17,19%	37,50%	45,31%
Total	**1,40%**	**4,20%**	**24,48%**	**42,66%**	**27,27%**

Source: own elaboration.

The exposed data reveal a broad consensus among the students on the adequacy of both methodologies. In the case of traditional collaborative work, 89.88% consider it adequate (30.38%), quite adequate (46.84%) and very adequate (12.66%). In the case of the group that used a mind map, 100%

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rated it between adequate (17.19%), quite adequate (37.50%) and very adequate (45.31%). Although both proposals are recognized as adequate, the best evaluation of the mind map stands out especially in the highest quartile, where 45.31% of the students consider it very adequate, compared to 12.66% in the case of the traditional collaborative methodology.

These results coincide with other studies (Ortega-Cubero and Coca, 2022), and reflect that this fact may be influenced by the effect of graphic analysis on the content worked on, which requires students to maintain a high concentration on what they read, to be able to express in a descriptive way the structure of the reading.

On the other hand, the students were asked to point out two notable values of the tool used. In the case of traditional collaborative work, the students valued their collaborative potential for conducting, understanding, and reflecting on the proposed task (52%), and the possibility offered by the tool to organise and summarise the content of the task. In the case of the mind map, the students describe it as an appropriate tool for collaborating (38%), for organising content (9.3%), and they also consider it a novel and creative tool (9%)

4.3. Learning outcomes

Any methodological change seeks to improve learning. Although a distinction must be made between the core learning of the subject of a conceptual nature and the basic skills that are also developed in this type of activity, such as teamwork, reading and critical commentary on curricular content, knowing teaching procedures and learning, learning to learn, digital skills, etc. In this work we have focused exclusively on aspects related to the comprehension of the analysed text, for this we built a test with three relevant and complex questions. The results are reflected in the following Table 4.

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Table 4.

Evaluation results according to the applied methodology

	Percentage of successes in the assessment test			
Methodology	**P1**	**P2**	**P3**	**Average of the test**
Traditional collaborative work	34,2%	35,4%	86,1%	52%
Collaborative work with mind map	50,0%	23,4%	82,8%	52%
Variation	15,8%	12,0%	3,3%	0%

Source: own elaboration.

The evaluation was done immediately after sharing with the class and the review of the work by the teaching staff. The table shows variations in one of the questions, but overall, the students in each group obtained an identical average result. We could conclude that the use of the mind map has not affected the learning acquired by the students. In any case, it is convenient to emphasise the idea that they are about conceptual learning, since certainly other aspects related to transversal competences could have different results. On the other hand, the evaluation is done after a class discussion on the most complex aspects of reading, it is possible that if it had been done before, the results could be different.

V. Conclusions

The motivation of this experience is driven by the need to find innovative formulas based on MECA to promote student learning. In this work we have analysed the effect on student learning with the introduction of traditional collaborative work dynamics plus an online collaborative tool to analyse texts through the creation of mind maps.

Since the student body is the ultimate reason for all educational innovation, we consider it essential to know the perception and experience of the student body. In this sense, it is remarkable that 20.3% had not worked with mind maps and the opinion of the students about the ease of the proposed online

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tool is linked to their experience, the more experienced students have a more positive opinion about the tool and spent less time developing the task.

On the other hand, there is a broad consensus among the students on the adequacy of both methodologies, but with a higher value in the case of the use of the mind map. This result may be influenced by the effect of using graphic digital tools and not so much by an improvement in the learning experience itself. In fact, when analysing the degree of learning obtained according to the methodology used, no variation is observed between the two groups, both groups achieving identical results.

It is also worth mentioning that the students highlight the importance of collaboration between classmates when developing the task, both the group that did the work applying the traditional collaborative format (52%) and those that created a mind map (38%). In the case of those who designed the mind map, they also indicated that it promotes creativity to organise and outline the content worked on.

It can be concluded that the use of the mind map, although it does not provide a significant improvement in learning, can be considered as a valid proposal to organise, and improve the comprehension of scientific texts and the learning of basic contents of subjects that can be complex due to the student body, even at the university level. However, it is not the only one that could be applied, so it would be interesting to broaden the comparison with other digital collaborative work tools. Finally, according to the opinion of the students, it would be interesting to delve into the impact of digital-mediated teaching compared to face-to-face experience.

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CHAPTER 6. THE USE OF DIGITAL PLATFORMS FOR SCIENCE LEARNING WITH 4TH GRADE STUDENTS: CHALLENGES, POTENTIALITIES AND DIFFICULTIES

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I. Introduction

We are part of a world marked by the constant need for updating and evolution, which stems from the systematic transformations "caused by the emergence of globalisation and the advent of the information society" (Cardoso, 2014, p. 13). As pointed out by Quadros-Flores et al. (2011), the improvement of technologies and their incorporation into the daily life of each individual has transformed the way relationships and communications are established. Thus, it becomes essential that this evolutionary process is accompanied by everyone, namely by schools and educational institutions, through the development of "challenging practices, integrating new pedagogical strategies and other teaching resources, namely digital ones." (Graça et al., 2019, p. 126). In the line of thought of the same authors, its incorporation in the classroom context enables the teacher to develop creativity and the ability to adapt to any unforeseen events, contributing to the holistic development of the child and his/her learning. Therefore, digital technologies, used as cognitive learning tools, were intended to develop students' complex thinking (Jonassen, 2007).

The present study is part of the intervention project - "Knowing and learning for a healthy diet to have", developed with a 4th grade class as part of the Supervised Teaching Practice (STP) curriculum unit of the Master's Degree in Pre-school Education and Teaching in the 1st Cycle of Basic Education. Its general objectives were: i) to make students aware of the promotion of healthier eating habits through the transformation of healthier food practices;

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ii) to identify foods and/or food practices that contribute to the proper functioning of the human body's systems (respiratory, circulatory, and others) and its organs (skin, muscles, and others); and iii) to understand the evolution of food over time, particularly since the recollecting and agropastoral communities, studying the origin of certain foods that make up the food wheel. It emerged from a conversation between the cooperating teacher and the class, when one of the students mentioned that at home he adopted healthier eating practices, the result of a visit to a nutritionist. This sharing led to a great interest on the part of the group by the theme, leading to the construction of this project.

It is in this sense that the learning unit - "For healthy skin to present, care should be taken" - was created, which aimed to identify the foods and/or dietary practices that contribute to the proper functioning of the body organs, in this case, the skin. In this chapter, we will focus on one of the activities included in this unit, which aims to develop students' digital literacy through the use of different digital technologies throughout the lesson, exploring the pedagogical intentionality underlying each of them and exploring their potential for students' learning.

II. Theoretical framework

Today's society brings with it numerous needs and demands that pose challenges to multiple sectors, particularly the educational systems, which must seek to devise strategies that can keep up with the changes that are emerging, as new ways of learning and teaching emerge. To this end, it is necessary that institutions and education professionals assume this change and seek to integrate new teaching methodologies into their educational practices, as is the case of active methodologies, which start from situations close to the child's daily life, which combined with varied resources, including digital, enable greater student involvement in the learning process (Moran, 2015).

Among the various existing active methodologies, *Design Thinking* should be highlighted, since its characteristics and different phases were approached during the actions developed in the STP context. In this sense, it is a methodology that aims to find solutions or identify improvements to problems, applying mechanisms such as creative thinking and collaboration (Stumm & Wagner, 2019). Also in the authors' view, during the course of the process, the educational professional assumes the role of mediator between the student and knowledge, providing access to multiple resources, in which the student is an active element in the construction of his learning. It begins

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with a question or challenge that directs the course of the different phases that follow. The first phase, *Discovery*, encompasses a first analysis and consequent understanding of the problem (Oliveira, 2014). Next, the *Interpretation* phase is the sharing of opinions and previous knowledge about the topic, issue or challenge under study. During this stage it is common for conflicts to arise, given the diversity of points of view, so the teacher has a key role in mediating them (Filho et al., 2015). The third phase, *Ideation*, encompasses the formulation of ideas to guide the investigative process, and it is common to develop mind maps as a way to structure and organise the thinking to follow (Stumm & Wagner, 2019). In phase four, *Experimentation*, the previously defined ideas and hypotheses are put into practice through different strategies and resources. Finally, the *Evolution* phase, in which all participants reflect, individually and together, on the entire process developed, analysing the results obtained and establishing a comparative bridge between the initial knowledge and the current informational baggage, thus enabling access to an active and self-evaluative teaching-learning methodology (Stumm & Wagner, 2019). It was, therefore, these phases that we sought to implement throughout the learning unit constructed.

Among the multiple resources that can assist in the integration of different active learning methodologies and, in this way, enrich the learning process, we highlight the technological resources that, as Quadros-Flores et al., (2012) state, "have played a particular role in shaping society over time" (p. 92). Their introduction in the social panorama and, particularly, in the school context represents the opening of a window of opportunities for educational institutions. In the author's line of thought (2012), its incorporation in the exploration of content in the classroom contributes to the student's development of multiple skills and acts, simultaneously, as a stimulus that generates encouragement, contributing to a progressive improvement in learning, when its use is effectively conceived as a cognitive tool that develops their complex thinking (Jonassen, 2007).

Of the various technological tools used, it is important to highlight *Educaplay*, *Wordwall, Mindmup, Animaker*, and *Youtube* as resources that integrated the learning unit presented in this chapter. The first, *Educaplay*, is an interactive platform that enables the digital development of activities (Salazar, 2014), allowing the "consolidation of knowledge" (Graça et al., 2021a, p. 98), but allows the development of different skills in the various moments of the lesson, thanks to its versatility in the types of activities it proposes. The *Wordwall* application also includes activities of different nature, which can be explored individually or in teams, contributing to the development of skills such as logical reasoning, autonomy, concentration

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and dexterity (Jesus & Mota, 2021; Sales et al., 2022). Regarding the *Mindmup* platform, it enables the creation of mind maps, in digital format, which can be revisited and changed whenever necessary, helping students to track their progress and schematize their own thinking. As for *Animaker*, this consists of a resource that provides for the creation of creative educational videos, consisting of a panoply of animations and elements that favour the creativity of each child, as well as enhancing their learning through this video construction (Marpaung & Hambandima, 2019). Finally, *Youtube,* a platform recognized worldwide for its variety of content, particularly educational content. *Youtube* is easily accessible and provides "dynamic and interactive" (Narciso et al., 2020, p. 1) content that enhances educational actions. Thus, the exploration of technological resources when framed in active methodologies, and with a defined pedagogical intentionality, can contribute to an increasing motivation of students for the construction of their learning, since they assume a participatory posture throughout the process, in a transdisciplinary approach.

In fact, curricular articulation proves to be fundamental in the learning process because, by articulating the different contents of the curriculum, students develop "readings and appropriations of reality in a contextualised and meaningful way" (Morgado & Silva, 2018, p. 47), and therefore, we sought to conduct transdisciplinary educational practices throughout the STP. At this level, the exploration of the various subjects does not occur in a segmented way; on the contrary, there is a "maximum degree of coordination between subjects" (Leite, 2012, p. 89) that allows students to understand and assimilate the different phenomena of the surrounding reality in an effective way (Graça et al., 2021b). Based on the assumption that themes of the reality surrounding students should be brought into the classroom, verifying their interests and curiosities, we proceeded to explore the theme of healthy eating, understanding its importance for the proper functioning of the human body organs, such as the skin.

Therefore, schools and educational institutions should explore this topic with children, encouraging them to learn about the food wheel and its different components, consume healthy and varied foods, and increase their daily intake of water (Direção Geral de Saúde, 2020). In fact, increased water intake is essential for the human body, since the lack of water affects the functioning of different parts of the body, hinders body temperature regulation, and impairs cognitive functioning (Padrão et al., 2014). In addition, it is during childhood that children begin to establish their food preferences and adopt behaviours that may affect, positively or negatively, their development. Finally, the restrictions imposed by the pandemic situation

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caused even more changes in children's daily lives, affecting their routines and eating habits, and leading to a high rate of obesity, so it is important to make students aware of these health issues that influence their learning process.

III. Research methodology and data collection techniques of the study

Throughout the developed project, the Action-Research methodology was used, since it has potential for improving educational actions, as there is "a progressive variation between understanding, change, action and critical reflection of teaching practice" (Fonseca, 2012, p. 18). It is characterised by offering a critical and interventive stance towards what is observed with the purpose of transforming it (Coutinho et al., 2009).

In this sense, observation proved to be essential to collect data on the students' interests, needs, and difficulties, providing relevant information for the construction of more appropriate and relevant learning units, in a direct, participant and systematic way, allowing for the collection of authentic information about the focus group (Cardoso & Rego, 2017). Data were organised into daily records based on the dialogues and interactions that were established, observation grids, pre-observation scripts, daily and photographic records, as well as interviews with the cooperating teacher for a better characterization of the class and, in turn, to act more appropriately in the educational reality, particularly when planning was being developed. Reflection accompanied the whole educational process, being an important tool for improving educational practices and increasing the group's success (Alarcão, 2021).

3.1. Study Participants

In this study, 24 4th grade students (aged 8 to 10 years) from a school cluster in Porto participated. The class showed difficulties in the area of Portuguese in terms of spelling, and in the area of Mathematics, particularly in the interpretation and mobilisation of strategies to solve challenges. Regarding interests, the group appreciated the area of Expressions, in the subdomain of Visual Arts, the area of Portuguese in the construction of texts, and the area of Environmental Studies, showing curiosity for the theme of the human body. It should also be noted that the room had an interactive whiteboard and a computer with internet access, but there were no computers for the students and the internet was unstable, which influenced the development of the activities.

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IV. Practical experience / Empirical experience

During the STP the project "Knowing and learning for a healthy diet to have" was built, with the previously mentioned objectives, which included seven pedagogical interventions, as shown in table 1.

Table 1.

Identify the sessions of the intervention project and their objectives.

Intervention sessions	Main goals:
1ª Session "What care should be taken for the proper functioning of the respiratory system?"	• Recognize and explain some benefits of a healthy diet for the proper functioning of the respiratory system; • Identify foods that contribute to the proper functioning of the respiratory system (citrus fruits, garlic, ginger).
2ª Session "If the heart is an involuntary muscle, why can bad habits cause it to stop?"	• Recognize and explain some benefits of a healthy diet for the proper functioning of the circulatory system;; • Identify foods that contribute to the proper functioning of the circulatory system (berries, nuts, spinach).
3ª Session "Invented Fruits, Mixed Fruits"	• Recognize and explain some benefits of fruit consumption for the proper functioning of the body.
4ª Session "Healthy skeleton, recommended!"	• Recognize and explain some benefits of a healthy diet for the proper functioning of the human skeleton; • Know some foods beneficial for the proper functioning of the human skeleton (chestnut).
5ª Session "For healthy skin to present, care we must adopt"	• Recognize and explain some benefits of a healthy diet and water intake for healthy, hydrated skin.
6ª Session "From the first peoples to the present day, a diet with variety"	• Understand and explain the diet of the first communities (recollectors c agropastoralists); • Understand and explain the evolution of food over time, from the first peoples to the present day.

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7ª Session "Christmas traditions: understanding the present by looking at the past"	• Identify foods from the food wheel brought by the Romans and Muslims; • Establish a comparison between the foods on the food wheel brought by the Romans and Muslims and the foods consumed today.

Source: own elaboration.

In this context, digital technologies based on active and participatory learning methodologies were integrated into these intervention sessions, according to the intended pedagogical intentionality. However, in this article we will only focus on lesson 1 of the learning unit, in which a variety of digital platforms were used to develop students' digital, personal and social competencies (Table 2).

Table 2.

Didactic course of lesson 1 of the learning unit.

Didactic Route	Goals	Essential Learnings	Resources
• Survey of students' previous ideas about the question "What care should we have with our skin?" and construction of a mind map, using the *Mindmup* platform;	• Identify and understand students' prior ideas about the topic; • Handle the digital platform to express their ideas and thoughts about the topic.	• Select relevant information according to the listening objectives and record it using various techniques; • Ask for and take the floor and respect others' speaking time; • Participate with commitment in oriented speaking activities, respecting specific rules and roles; • Use speech to express opinions and share ideas audibly, with good articulation, intonation and rhythm.	• Computer; • *Mindmup* digital platform;
• Viewing a video about the different components of the skin, using the digital platform *Animaker*;	• Explore and understand the different constituents of the skin; • Handle the digital platform for concept exploration;	• Select relevant information according to the listening objectives and record it using various techniques; • Recognize simple body defense mechanisms and disease prevention; • Use the computer and other digital devices as tools to support the investigation and research process;	• Computer; • Interactive whiteboard; • *Animaker* digital platform;
• Realization of a game about the contents covered,		• Select relevant information according to the listening objectives;	

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using the digital platform *Wordwall;*	• Identify the different constituents of the skin; • Handle the digital platform for the consolidation of concepts;	• Ask for and take the floor and respect others' speaking time; • Participate with commitment in guided speaking activities, respecting specific rules and roles; • Recognize simple mechanisms of defense of the body, and prevention of disease; • Identify the potential and main functionalities of tools to support the process of online research and investigation.	• Computer; • Interactive *Whiteboard*; • *Wordwall* digital platform;
• Construction, in working groups, of a skin model, using plasticine;	• Represent the different constituents of skin; • Collaborate with colleagues in the exploration of the material and in the construction of the final product.	• Use speech to express opinions and share ideas audibly, with good articulation, proper intonation and rhythm; • Recognize simple defense mechanisms of the body, for example, the skin as the first barrier of protection and prevention of disease; • Manifest expressive and creative abilities in their plastic productions, showing the acquired knowledge.	• Computer; • Plasticine;
• Exploration of the different functions of the skin, using everyday materials;	• Explore materials presented; • Understand, through manipulation of the materials, the different functions of the skin	• Use speech to express opinions and share ideas audibly, with good articulation, proper intonation and rhythm; • Recognize simple defense mechanisms of the body, for example, the skin as the first barrier of protection and prevention of disease.	• Materials (water, ice, cotton, flour, orange peel, rock salt, crepe paper, pen clip);
• Viewing of a video about the functions of melanin, using the digital platform *Youtube*;	• Explore the concept of melanin and its function in the skin;	• Select relevant information according to the listening objectives and retrieve it through various techniques; • Identify the potential and main functionalities of tools to support the research process and *online* research.	• Computer; • Interactive Whiteboard; • *Youtube* digital platform;
• Realization of a game about melanin, using the digital platform *Educaplay*;	• Explore the concept of melanin and its function; • Handle the digital platform for concept exploration;	• Ask for and take the floor and respect others' speaking time; • Participate with commitment in guided speaking activities, respecting specific rules and roles; • Select relevant information according to the listening objectives;	• Computer; • Interactive Whiteboard; • Educaplay digital platform;

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		• Use the computer and other digital devices as tools to support the investigation and research process;	
• Reading "Racism and Intolerance" by Louise Spilsbury	• Analyse work and identify key points; • Understand the difference between racism and intolerance; • Compare the message of the work with everyday life;	• Listen to read literary texts and express reading reactions in a creative way; • Explain key ideas of the text; • Select relevant information according to the listening objectives (...);	• Book "Racism and Intolerance" by Louise Spilsbury;
• Exploration of content related to word classes, based on the projection and analysis of an excerpt from the work;	• Identify the different word classes present in the highlighted words;	• Ask for and take the floor and respect others' speaking time; • Participate with commitment in oriented speaking activities, respecting specific rules and roles; • Use speech to express opinions and share ideas audibly, with good articulation, appropriate rhythm and intonation; • Identify the class of words;	• Computer; • Interactive whiteboard;
• Exploration of content related to word classes, using the digital platform *Wordwall*;	• Identify the different word classes; • Handling the digital platform for concept exploration;	• Ask for and take the floor and respect others' speaking time; • Participate with commitment in guided speaking activities respecting specific rules and roles; • Use speech to express opinions and share ideas audibly, with good articulation, appropriate rhythm and intonation; • Identify the class of words; • Use the computer and other digital devices as tools to support the investigation and research process;	• Computer; • Digital Platform *Wordwall;* • Interactive Whiteboard;
• Construction of a bar graph with the different skin tones of the students in the class;	• Identify different skin tones of the class; • Group the information according to the data obtained; • Build a bar graph about the information;	• Participate with commitment in oriented oral expression activities, respecting specific rules and roles; • Solve problems involving the organization and processing of data in various family contexts;	• Daily notebook;

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• Construction, in working groups, of a brief dramatic situation about a racist attitude and a possible solution;	• Identify racist situations and mobilize solutions; • Work collaboratively; • Plan the presentation of the situation and represent it;	• Plan, produce and evaluate short oral speeches, with varied vocabulary and complex sentences; • Use processes of planning, textualization and revision; • Produce short scenes from real or fictional data; • Build characters, in different situations and purposes;	• Daily notebook;
• Making an alphabet soup about the contents discussed, using the digital platform *Educaplay;*	• Identify and consolidate the main concepts; • Handle digital platform for the consolidation of content;	• Select relevant information and record it using various techniques; • Recognize simple defense mechanisms of the body, for example, the skin as the first barrier of protection and prevention of disease;	• *Educaplay* digital platform;
Descriptors of PASEO • Knowledgeable/knowledgeable/educated/informed (A, B, G, I, J); • Communicator (A, B, D, E, H); • Systematizer/ organizer (A, B, C, I, J); • Participative/collaborative (B, C, D, E, F); • Creative (A, C, D, J); • Reader (A, B, C, D, F, H, I); • Questioner (A, F, G, I, J); • Respectful of difference/ the other (A, B, E, F, H)			

Source: own elaboration.

The pedagogical action began with the survey of students' previous ideas about the problem question: "What care should we take with our skin?", seeking students to assume their voices "as participation and as a right" (Costa & Sarmento, 2018, p. 74). We obtained answers such as: "We should drink water", "We should not get tattoos", "It is important to eat well", which were organised in an online mind map built by the students themselves using the *Mindmup* platform. Their construction allowed us to verify that some students already had relevant ideas about the importance of maintaining good eating habits and their influence on the good functioning of the different organs of our body, namely the skin. Then, a new question was posed: "Is the skin all the same thickness?", and the students were challenged to touch several parts of their bodies (eyelids, elbows, cheeks), establishing a learning moment, through touching their bodies, concluding there were places that presented a greater thickness than the others.

Subsequently, taking into account the fact that Information and Communication Technologies contribute to a more dynamic and participatory learning process (Garcia et al., 2012), a video was presented by the trainee teacher on the *Animaker* platform with information about the various

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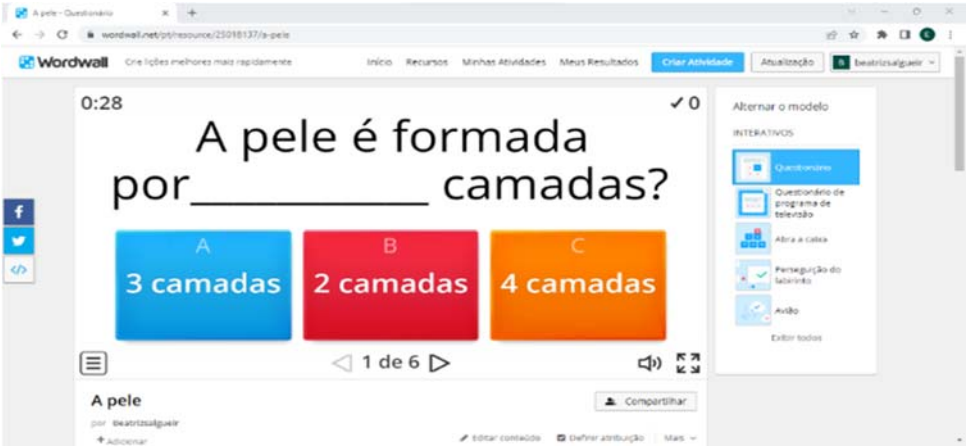
components of the skin. As a way to explore the theoretical concepts discussed and given that one of the group's interests was related to the development of challenges and games, a game was presented on *Wordwall* (Figure 1), and it consisted of a set of blanks which should be completed with the correct answer about the topic studied.

Figure 1.

Example of a question in the Wordwall platform.



Source: Own authorship.

Taking into account that the dynamics of group work was an aspect to be improved in the class, we tried to develop activities with this purpose. Thus, we proceeded to the projection of a representative image of a piece of skin. Each group received a box with plasticine of different colours, and was challenged to represent the excerpt, culminating in a model with the three layers of the skin: epidermis, dermis and hypodermis. In order to explore the different functions of the skin, different materials were assigned to each of the groups - water, rock salt, ice, orange peels, flour and cotton - and, through a set of guidelines provided by the trainee teacher, the students were invited to explore the various elements.

After addressing the constituents of the skin and its functions, a new challenge was proposed to the group: "Why is the skin of some people darker and others lighter? The question led to a moment of sharing of ideas that were clarified by watching a video on the *Youtube* platform, in which it was possible to address the definition of melanin and its respective function in an

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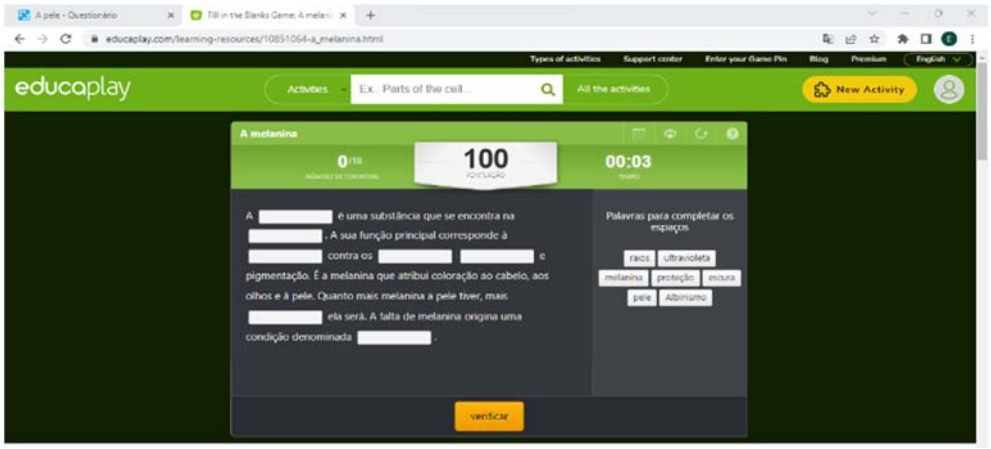
interactive way, developing information retention skills about what was viewed. As a way of consolidating the knowledge mentioned throughout the video, a new game was proposed (Figure 2), created from the *Educaplay* platform.

Figure 2.

Game developed on the Educaplay platform.



Source: own elaboration.

To start the next activity, the class was again asked: "The colour of people's skin is often a reason that leads to racist situations, isn't it? Have you ever witnessed any situation of this kind?" and, instantly, a dialogue began among all the students, ascertaining that no one had experienced racist and/or intolerant actions. Based on this interest, the book "Racism and Intolerance" by Louise Spilsbury (2018) was read, presenting the reader with situations of racism and intolerance and offering a wide range of strategies to help the reader understand and overcome them. After reading the work, again using the *Wordwall* platform, the group was invited to discover concepts that were hidden in an alphabet soup (Figure 3), and to explore and connect them to their true definition.

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Figure 3.

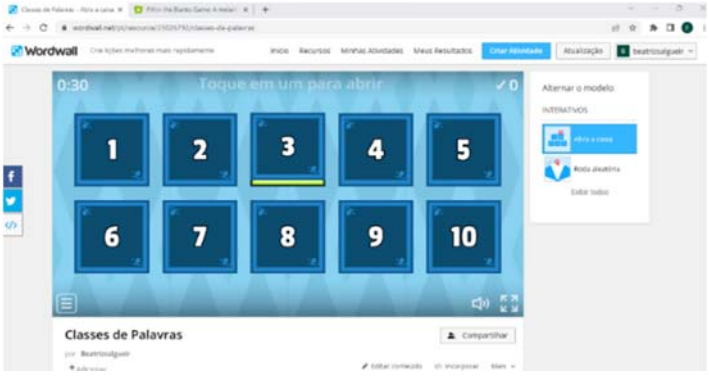
Wordsword created on the Wordwall platform.

Source: own elaboration.

In dialogue with the cooperating teacher, she expressed some concern about reviewing some grammatical contents related to word classes. Taking advantage of the story read, the trainee teacher chose, in a first phase, to project an excerpt of the text read and based on it, encourage students to discover different word classes. To complement this exploration, the teacher also challenged the students to choose a mystery box and to answer the underlying question, using the digital platform *Wordwall* (Figure 4).

Figure 4.

Mystery game boxes created on the Wordwall platform.



Source: own elaboration.

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Finally, the influence of melanin in the pigmentation of eyes, hair and skin tone was explored, first through the analysis of a table from the Environmental Study manual, and then through the creation of a bar graph representing the different skin tones of the group's elements: very light skin, light skin, dark skin and very dark skin, enabling the construction of a graph, working mathematical skills and linking with information from the student's everyday life (Decreto-lei n.º 241/2001, de 30 de agosto). In turn, students were challenged to create a dramatic situation involving a racist action and a solution to it, in an articulation between the areas of Visual Arts, Portuguese and Citizenship. Thus, several digital platforms were used at different moments of the class with different pedagogical intentions in order to develop students' learning and several competencies present in the guiding documents.

IV. Results

The data analysis and discussion will focus on two aspects: i) the impact of the use of technological tools on students' learning; and ii) the potentials and difficulties in the use of digital platforms by the trainee teacher, using the observation notes (NO) and reflective narratives (NR) of the trainee teacher, and also some of the students' interventions (A).

4.1. Impact of the use of technological tools on student learning

Regarding the use of the different digital platforms (*Educaplay, Wordwall, Youtube, Animaker, Mindmup*) in the various moments of the class for the exploration of the skin theme, it was possible to verify that, *"during their handling, the students were motivated, interested, very participatory, establishing an enriching learning climate."* (NR). In this sense, it is important to understand the use of ICT through the voice of the students, verifying that its use enhances motivation, enthusiasm, willingness to learn: *"It's fun!"* (A2); *"I like these games."* (A5); *"I really like to answer."* (A7); *"Can we do it more often?"* (A10), contributing to an environment that is rich and conducive to learning.

As for the use of the digital platform *Wordwall*, it was found that *"This moment generated a motivating and interactive atmosphere, in which children worked collaboratively to achieve the correct answer, thus mobilising the knowledge they had built, thus working as a way to consolidate their learning about the theme."* (NR). However, the mentioned platform has other features, such as the alphabet soup, which allowed exploring, in an interactive way, the key ideas of the presented work, providing *"an easier interpretation of the*

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concepts, besides developing aspects such as visual perception and students' attention span" (NR); the multiple-choice modality allowed students to explore concepts about the different layers of skin and, simultaneously, *"develop the ability to understand and interpret statements, reasoning and consolidate definitions"* (NR); and, also, the mystery boxes *"aroused great interest in children who, motivated by the mystery associated with the choice, waited anxiously for their turn to select and answer"* (NR). Through this feature, it was possible to notice that students *"were attentive, motivated, worked in teams to discover the mystery question, positively impacting their ability to understand and assimilate the content"* (NR).

As regards the *Educaplay* platform, which had several tools and didactic resources, it allowed *"the group, through the challenge of completing the blanks, to work collaboratively to mobilise concepts and improve their ability to interpret the statements"* (NO). Thus, based on the use of these two platforms, we found that *"thanks to its versatility and variety, Wordwall and Educaplay allow us to explore multiple concepts and diversify the dynamics that are developed in group-class"* (NR).

As regards the use of the digital platform *Youtube*, as it is an application that is part of the students' daily life, *"it allowed them to realise the educational variant that this tool has. Thanks to its dynamism in the articulation between sound and video, it raised the students' attention to the themes that were addressed"* (NO). The technological tool *Animaker*, by providing several interactive features that allow the preparation of dynamic videos, was an asset to the class, since *"One of its features includes the possibility of regulating the time of the message transmitted, facilitating the concentration and assimilation of the student to the contents that are disclosed, besides allowing the student to interact with the video"* (NR). Regarding the use of the *Mindmup* digital platform, "a closer contact between the class and the technology was made possible, where each student had the opportunity to register his answer in the tool and, thus, build a collaborative mind map, offering a broad view of each one's shares and contributing for the group to feel comfortable in the manipulation of technological tools in the classroom" (NO), favouring the students' teaching and learning process.

Indeed, it can be seen that the use of ICT has contributed to the increase of the child's attention and commitment (Quadros-Flores et al., 2011), to the development of multiple skills, positively impacting the construction of meaningful and contextualised learning, and to the mobilisation of concepts worked in the classroom to everyday situations (Lento et al., 2018).

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4.2. Potentials and difficulties in the use of digital platforms by the trainee teacher

In view of the rapid changes that we are witnessing in our daily lives, it is essential that education professionals are pioneers in the way they adapt to the challenges that arise, and the trainee teacher always tries to build educational practices that would meet these changes. In this sense, during the practice developed, it was essential to incorporate innovative strategies in the pedagogical actions that were built to address the difficulties of each student and, simultaneously, guide students' learning success (Serrano de Carvalho, 2018).

In this way, it is important to refer to the challenge that was the integration of digital technologies in the educational process. Reflecting on the training process, becoming aware of oneself and one's limits in the context of pedagogical and technological knowledge is essential for the professional development of teachers. According to the trainee teacher's experience, although she considered the mobilisation of technological resources to the school environment pertinent, initially its integration brought difficulties: *"Although the classroom had resources such as computer and interactive whiteboard, the internet network often failed, making it difficult to integrate technologies in the dynamics. In addition to this factor, during the first planning sessions when I was challenged to integrate ICT in the context, I realised that I had very traditionalist ideas. The proposal to integrate ICT revolutionised the way I looked at education".* (NR).

These first difficulties were evidenced in the reflective narrative of the trainee teacher, but they were not inhibiting reasons for the construction of innovative practices, as she was willing to diversify her practices, in an openness to change and updating, in order to provide students with *"favourable conditions for the development of their skills*" (Gouveia, 2016, p. 24). However, it is important to highlight that, although the classroom had technological resources such as computers and interactive whiteboards, and the cooperating teacher used them with some frequency, the fear of not engaging students in learning was present: *"Students come into contact with technology every day. This particular group was active, participatory and extremely interested in exploring technological tools. I found that the students with more difficulties felt more comfortable when the topics were covered in digital resources. Thus, I needed to bring innovative challenges to capture the group's attention and motivate them to learn. I felt that I had to challenge myself to develop different dynamics and work with the concepts in a different way."* (NR).

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To assist in this process of selecting digital platforms and developing a knowledge articulation between them and the contents to be addressed, it is essential to highlight the collaborative work developed with the institutional supervisor, the cooperating teacher and the pedagogical pair who, through dialogues, provided moments of reflection, questioned knowledge and paid attention to the difficulties experienced, often articulating theoretical and practical concepts (Ribeiro et al., 2016): *"The collaborative work was essential for the construction of enriching practices. Through the dialogues developed with the cooperating teacher, the pedagogical pair and the institutional supervisor, we were able to share our fears, discuss strategies and solutions to the challenges that emerged, and get to know multiple digital platforms (many of them used in the elaborated dynamics), which contributed to the development of my digital literacy and that of the group".* (NR).

It should be noted that, during the implementation of the dynamics, one of the main difficulties was time management, opting for offering time to the student to explore the digital platform: *"When we give the student a digital platform and allow him to explore it autonomously, it is important to respect his pace. As children have different rhythms, sometimes the time that was planned for a particular activity ended up being extended, conditioning the course of the following activities. Also, here the role of collaborative work proved to be pivotal."* (NR).

The dynamics of the actions presented above, and the incorporation of digital platforms, had a very positive impact, both on student learning and on the development of students' and trainee teacher's digital literacy, as evidenced in her reflective narrative: *"It was possible to explore different themes with the children and allow them to access a variety of information from the real context, thus broadening their information baggage and enabling them to realise the importance of ICT as a mechanism to learn about the world we live in. The practice developed allowed us to see the need to respect each child and provide them with enriching educational paths, which provide the necessary foundations to face the adversities of the future with security and confidence".* (NR).

Thus, the trainee teacher overcame the difficulties, sought to build knowledge about the use of different digital platforms in student learning, finding solutions that allowed to carry out the educational practice, envisaging new ways of learning and teaching, with a view to the professional development of teachers, since professional growth, as Graça et al. (2019) state, is materialised by the experiences carried out in real contexts, in a joint

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and interactive dialogue with the agents involved, for a renewal of educational practices.

V. Conclusions

The rapid evolution of society brings with it numerous challenges that directly or indirectly affect society, including education. One of these challenges includes the incorporation of technologies in the classroom, given their potential to promote learning and skills in students. The teacher cannot escape this reality and must seek to create opportunities for its integration in the classroom.

With regard to the activity conducted and the platforms used in it, we can conclude that the use of technological resources by students enhanced their learning, contributing to the development of reasoning, critical and creative thinking, autonomy, teamwork and others, and increased concentration and motivation. In addition, it enabled the development of digital literacy, not only in the students but also in the trainee teacher, who embraced the challenges and tried to build practices directed to the challenges required in this century, from a constructivist perspective.

On the contrary, it is fundamental that professionals try to develop dynamics that can keep up with the evolution of society and allow students to grow and develop in a holistic way, capable of facing the challenges of the future.

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CHAPTER 7. THE POTENTIAL OF DIGITAL TOOLS IN 1ST CEB IN PORTUGAL: TRAILS TRAVELLED BY TEACHERS IN TRAINING

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I. Introduction

Nowadays, there is a concern to prioritise teaching using educational technologies (Silva, 2020), strategies and participatory methodologies (Morin, 2018; Raposo-Rivas et al., 2020) that foster the work of a committed, responsible and transforming citizenship, capable of promoting inclusive, equitable and quality education. In addition, we aim to develop lifelong learning opportunities that promote the understanding of education as a fundamental human right. As such, there has been in Portugal a work of promotion and integration of technologies in education, with a special investment in the development of digital skills of teachers and students (Portugal Digital, 2022), as well as in the equipment of the technological school park. It is, therefore, up to the school to assume the institutional commitment to educate according to the principles of a digital and network society, trying to meet the challenge through an educational model (Gallego & Raposo-Rivas, 2016) and democratic model that seeks to train the citizens of the 21st century. However, this fact requires the existence of a project that promotes a culture of pedagogical and technological change in schools, that creates measures to overcome obstacles to change and improve educational environments, that designs, develops and evaluates the process of virtual teaching and learning, that promotes a leading role of the educational

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community as an agent of change and school improvement (Sancho, 2006). Thus, it is possible to highlight a new pedagogical paradigm showing the metamorphosis of the concept of teaching and learning, the attitude of the teacher and student and the role of technologies in the classroom (Gomes, Escola & Raposo-Rivas, 2016).

The use of Information and Communication Technology (ICT) in innovative educational practices (Muñoz et al., 2015) contributes to greater student engagement, participation and motivation, which subsequently translates into more active learning. Children are currently familiar with ICT, being a digital generation, which means that teachers and schools must also be of the same age (Quadros-Flores et al., 2009). Thus, it is understood that ICT tools help to approach contents in a clearer, more attractive and dynamic way, allowing students to consolidate their knowledge. In addition, these tools also allow the promotion of diversified pedagogical strategies that enable to meet the individual differences of each student (Quadros-Flores, 2016).

This study is the result of an intervention project entitled "A Journey through Traditional Games and Oral Literary Heritage", developed with a 3rd grade class, not only within the scope of the curricular unit Supervised Teaching Practice (STP), integrated in the 2nd year of the study plan of the Professional Master's Degree in Pre-school Education and Primary School Teaching, School of Education of Porto, Polytechnic Institute of Porto, but also within the scope of the Digital Skills course conducted by Dr. Cristóbal Torres Fernandez, from the University of Valencia, Portugal, in which the students in training had the opportunity to participate.

Thus, we reflect on some practices, organised into learning units (Viçosa et al., 2017), and developed in four interventions, based on the Project Work methodology. These practices, developed under the aforementioned intervention project, had two main goals, namely, understanding the importance of Heritage; and the knowledge and exploration of the Portuguese Oral Literary Heritage and some of its traditional games, considered as Intangible Heritage. Thus, the use of ICT as resources and strategies for pedagogical action, as well as the reading of "literary works and texts of popular tradition", the "dramatised reading of literary works" (Educação, 2018, p. 9) and the recognition of "customs and traditions" (Educação, 2018, p. 5) allowed meeting the needs, difficulties and interests evidenced, culminating in evidence of significant learning of students.

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In this sense, the problem question "How do ICTs in the 1st CEB contribute to student learning?" was raised, in which we sought to understand the potential of some digital tools (such as *Wakelet, Wooclap, Edpuzzle, Metaverse, Ted. Ed, eXeLearning, Plickers, Piktochart*), not only as a resource/strategy for student learning, but also for the development of pedagogical practices in 1st CEB, according to the perspective of the trainee teachers, through the Action-Research methodology.

II. The integration of ICT in the classroom

Currently in Portugal, articulated with the Decree-Law No. 55/2018, the curriculum guidance documents called Essential Learning (EA) are in force, which aim to promote the development of the areas of skills included in the Profile of Students Leaving Compulsory Schooling (PASEO) (Order No. 6944-A/2018, of July 19), in which flexibility, transdisciplinarity and articulation of the various curriculum areas are assumed as a necessity. Thus, schools have benefited from autonomy and flexibility to the extent that the flexibility of time and space and curriculum adaptation has enabled the use of ICT and the inclusion of students with special educational needs (Silva, 2000). In the inclusive school that "integrates students with different problems and difficulties of access to the curriculum, the use of ICT is essential as a resource that allows differentiated and individualised strategies, enhancing the activities and participation of these students" (Filipe et al., 2019, p. 68).

Under the premise of this empowerment and the participation of students in their learning, it is important to highlight the work based on participatory pedagogies, including the Project Work Methodology (PPM), which focuses on "solving relevant and real problems" (Mateus, 2011, p. 3) that are solved based on time, people, resources and taking into account the community in which the group is inserted. This methodology enables compliance with the curricular flexibility proposed in the Decree-Law no. 55/2018, of July 6, as it enables the transdisciplinary nature of learning, collaborative and interdisciplinary work and evaluation of the whole process, with the child being active in the construction of knowledge. Thus, a new way of learning emerges, closely related to the educational pillars advocated by Delors et al. (1998), with the perspective of learning centred on play and playfulness (Neto, 2020), integrated in the ecological perspective of Bronfenbrenner (Assis et al., 2021).

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Thus, the use of active methodologies and pedagogies combined with the use of ICT will not only motivate students who need pedagogical differentiation, but also all others, because the digital language belongs to everyday life, evidencing itself as a new perspective of communication, where there are new forms of production and dissemination of information in real time (Cunha & Bizelli, 2016).

The evolution of the teaching-learning process to adapt and develop critical and active citizens enables the use of didactic software and applications that help in various intellectual tasks (Bittencourt & Albino, 2017). The use of Educommunication, a term referred to by Soares (2016) as cited in Bittencourt and Albino (2017), conceives a type of learning using technological resources and valuing new relationships in communication, focusing on the process rather than the content or the final product. In accordance with this type of learning we can evoke the promotion of students' digital literacy, being conceived as the ability of the student to understand, select and use information in their daily lives (Oliveira & Giacomazzo, 2017).

Therefore, it is the teachers' responsibility to prepare the student for the constant development of the world that awaits him/her outside of school. This preparation is only possible when the teacher rethinks the curriculum taking into account the inclusive school context and the scientific knowledge of the various subject areas, in order to develop the necessary skills for students' learning. Thus, the student, upon leaving compulsory school, should have an integrated knowledge of the subjects of the curriculum, as well as a set of more general skills that will define him/her as a citizen (Roldão et al., 2017). It is therefore paramount to rethink the curriculum and adapt it to current needs, considering digital native students. Fontoura (2006) states that there are several "political and ideological pressures and tensions" (p. 39) that directly affect the construction and definition of the curriculum.

The use of ICT in education allows students to identify with it, create a bond of proximity and develop individual and social skills, considering the educational purpose with the use of ICT, as well as the students' needs and difficulties (Roldão, 2009). In teaching practice, it is essential that the teacher knows and uses several tools of different natures that can be combined with each other, enabling a coherent learning unit, directed to the current society and to the students' digital needs. These units can be defined as facilitating the construction of the student's knowledge, considering his/her interests, wishes and needs. It is developed in a transdisciplinary way, methodologies and strategies are explained and it has a flexible character (Viçosa et al.,

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2017). In the present study we used digital tools from the categories explained in Table 1.

Table 1.

Categories of the tools used in the study.

Digital Tool Category	Tool name and logo
Organization of Ideas	*Wooclap* - an interactive platform used to create surveys and questionnaires.
Content Creation	*Piktochart*- graphic designer tool and infographic creator. *Metaverse* - create virtual reality experiences.
Communication and community	*Zoom*- remote conferencing service that combines video conferencing, online meetings, and other features.
Evaluation and gamification	*Edpuzzle*- video lesson creation tool. *Ted.Ed*- create and share interactive lessons. *Plickers*- assessment tool through questions answered with QrCode.
Content Management	*eXelearning*- programmable software with several resources, from videos to quizzes, among others. *Wakelet*- platform for organizing and sharing content. Allows the organization of links, images, and videos into collections.

Source: own elaboration.

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The use of ICT in the classroom requires the existence of structural conditions that allow it, namely the existence of technological equipment, available internet and good working conditions (Graça, et al., 2021). It is also essential that teachers have training in ICT, that they know the functionalities of the various technological equipment, as well as their advantages and pedagogical potential.

Nowadays, in Portugal, there are still many education professionals who do not include ICT in their teaching practice, precisely because there is no commitment to continuous training in this area and because many of today's teachers were trained at a time when ICT was not yet widespread throughout the world and in children's daily lives, sometimes showing some resistance to this change (Cunha & Bizelli, 2016). In addition, teachers who often use ICT use it without understanding the underlying learning (Peralte & Costa, 2007). It is crucial that teachers understand the need for this change, since children and young people are now digital natives, and that they aim to improve their practices and the teaching and learning process.

In this way, it is essential to train teachers in ICT, it is important that they understand the potential of ICT in the classroom and use it with an educational purpose. It is crucial that schools understand this new technological era and invest in a diversity of technological equipment and a favourable Internet network for the use of many of these gadgets, thus creating the necessary conditions for its use. In addition, the use of ICT in the study allowed the trainee teachers to develop their knowledge on how to plan digital activities, where the need to assess the students' level of preparation was raised as essential, correctly adapting the complexity of the proposed tasks (Dias & Correia, 2015).

III. Practical experience

3.1. Research methodology and data collection techniques of the study

The Action-Research methodology was used, a methodology which assumed the centrality of the action of the trainee teachers, since it is characterised as a "research methodology that simultaneously uses action and research in a cyclical process" (Fonseca, 2012, p.18) and allows for an active, reflective practice on and in action, promoting, from the perspective of teacher training, a constructivist learning, in which participant observation is privileged. Since this is a cyclical process at the educational level that allows teachers to become teacher-investigators (Latorre, 2005), innovative and reflective, we believe that this methodology is a foundation for the

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improvement, renewal and transformation of teaching practices and, consequently, of teacher training.

Thus, techniques and resources were used for data collection: (i) observation guides, structured according to identified and specific objectives (Correia, 2009); (ii) logbooks, where the moments observed were explained and reflected upon; (iii) photographic and videographic records; (iv) field notes, essential for recording critical incidents; and, finally, (v) questionnaire survey, structured with the intention of assessing the intervention project.

3.1.1. Study participants

In this study, 17 students from a 3rd grade class (8-9 years old), from the 1st cycle of basic education, from a school cluster in the metropolitan area of Porto, participated. It should be noted that the school cluster in question was equipped with a WI-FI network, tablets, computers, floor projector and several educational robots. However, it had some weaknesses regarding the internet (either wireless or cable), reflected in the consequent little use, by the teachers of the context, of technological tools and equipment in the educational action of the class teachers of the 1st CEB, making it difficult to conduct new practices.

The class was participative, committed and curious, always willing to solve challenges that promoted their active participation and, consequently, their own involvement in learning. They were particularly interested in working on Literature, Music, collaborative tasks, and Technology. Although they showed special interest in group work, the class had many difficulties with interpersonal relationships and cooperative work. Moreover, they had difficulties in Mathematics and Portuguese. It is important to emphasise that, considering the involvement of families essential to the development and learning of the student, they participated in the dissemination of the project, as well as the educational community, including the institution's pre-school groups.

The class had six students with evident difficulties, all of whom had a specific approach according to their skills, requiring pedagogical differentiation, as was the case with the formation of groups with more elements for containing a student with needs, so that he could be helped, as well as allowing the response through the applications, with the help of peers or even in accordance with these.

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IV. Construction of the Project work and evidence of the digital tools used

During the STP period in the 1st CEB, lasting about four months, the project "A Journey through Traditional Games and Oral Literary Heritage" was built (Table 2), whose main goal, among the others already mentioned, is to understand the importance of heritage through the exploration of the Portuguese Oral Literary Heritage and traditional games.

Table 2.

Actions developed in the project.

A journey through Traditional Games and Oral Literary Heritage

Session	Developed actions
1. **A journey with Nadir: creating in order to feel.**	Sharing traditional games; Construction of traditional games.
2. **To discover villages, the rocks and the proverbs I will feel.**	Proverbs; Robotics activity: Schist Villages
3. **A journey through the Portuguese landscape, stopping in the Alentejo and its typical expressions.**	Discovering typical Alentejo expressions
4. **Challenges cont(o)radition.**	The traditional tales; Dramatization "The tales".
5. **The (un)pollution of aquatic environments**	The traditional tales; Dramatization "The tales".
6. **An (in)conclusion.**	Traditional outdoor games; Dissemination of "The tales" dramatizations; Evaluation of the project.

Source: own elaboration.

This article will explain and analyse some of the activities of the sessions "A trip through the Portuguese landscape, stopping at the Alentejo and its typical expressions" and "Challenges cont (o) radition". It is reinforced that, in all learning units, technological equipment and digital tools were used in combination with active and participatory methodologies according to their pedagogical intentionality, even despite the inhibitions that existed in the

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educational context in which the practices were implemented, namely at the level of Wi-Fi network. Solutions were sought to promote the use of ICT, since we believe in its potential as a tool that fosters social constructivist practices (Quadros-Flores, et. al., 2009) and meaningful learning, in which the student is the centre of his/her own learning. Although the curricular area of Portuguese was the main thread of the project, it should be noted that curricular articulation was emphasised, with a view to the development of competencies and skills set out in the Essential Learning (Education, 2018) and in the Profile of Students Leaving Compulsory School (Martins et al., 2017), documents that guide educational practice in Portugal.

4.1. "A journey through the Portuguese relief, stopping in the Alentejo and its typical expressions"

This learning unit took place over two days. It should be noted that, as the students arrived to the classroom, it was already organised in order to allow group work, since this is an important strategy, because the groups were formed so that the students who had more difficulties would be with students who could help them, thus also acting in the Zone of Proximal Development (Papalia et al., 2001). In addition, since different digital applications would be used, many of them new to the students, this was a way to promote mutual help and cooperation. We will highlight only some of the activities that were used, in which digital tools proved to be paramount for the learning objectives proposed in this learning unit.

Thus, starting with the question "What is relief?", each group had access to the distributed tablets and accessed the *Wakelet* application, namely the *Wooclap* (platform that allows the realisation of various resources, from multiple choice questions, open answer questions, linking questions, idea clouds, creating presentations with slides, among other options) link, which they had to open in order to answer, with the trainee teachers assuming the role of mediators in its use. Since the class had never worked with this application, a previous explanation of how it works was necessary before the students started using it that same day. Thus, it is understood that the integration of applications in teaching practices is possible but requires that teachers prepare themselves in order to know how to use the application and what its pedagogical advantages are. At the end, the result of the initial brainstorming was analysed in the large group, and the different ideas were discussed, and several students answered that relief was associated with rocks, the shapes that the Earth had, and others referred, still, to some forms of relief that they knew.

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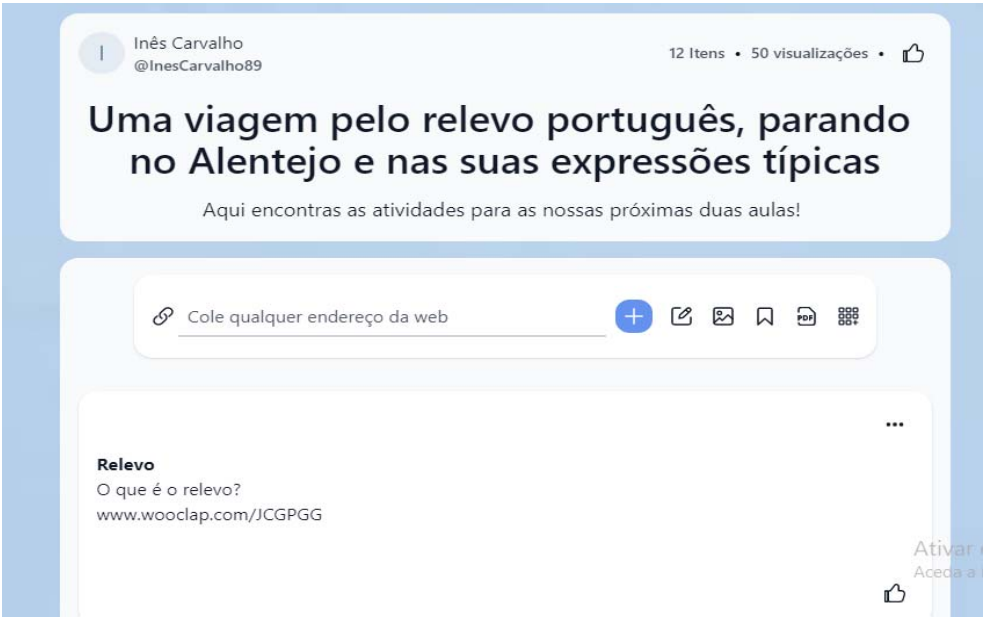
Figure 1.

Wakelet.



Source: own elaboration.

With these answers it was possible to notice that some students already had some prior knowledge about the topic and that others confused some concepts, which allowed guiding the subsequent dialogue about the characterization of the relief along the Portuguese mainland territory. This moment was important, because it allowed the survey and exploration of the students' previous knowledge about the theme, a key aspect to the teacher to help the transformation of tacit knowledge in the construction of new knowledge (Coll et al., 2001). The ease with which the students dealt with *Wooclap* was perceptible, as it resembles another application already used by them before. Thus, the easy handling of it should be highlighted, as well as the consequent autonomy that the application itself gives to the students.

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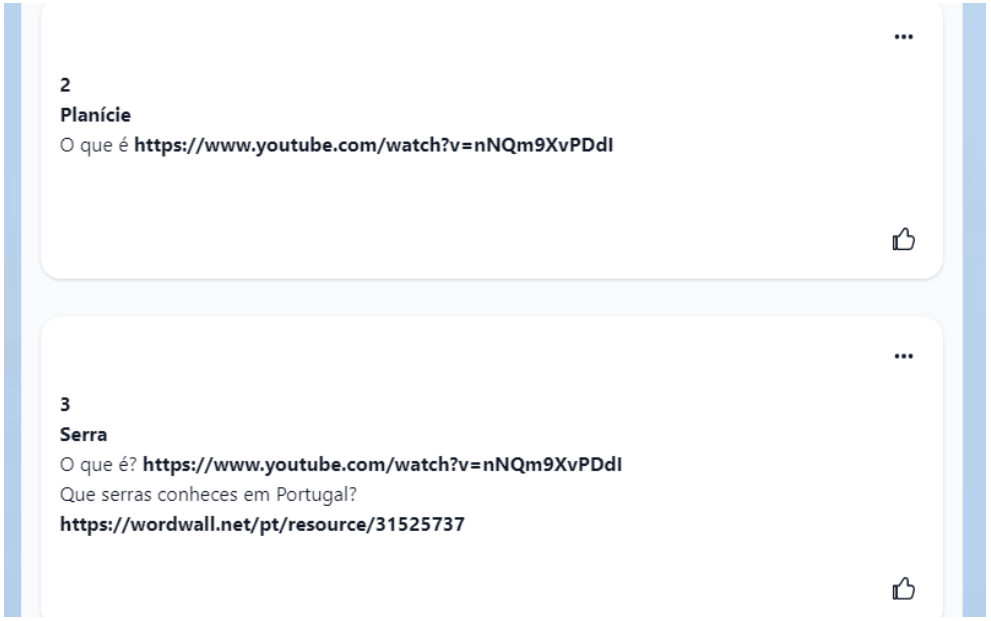
Figure 2.

Wakelet application as an aid to station-based rotation methodology.



Source: own elaboration.

After this moment, the students were challenged to find out more about the different types of relief in Portugal, and for this, the active methodology of rotation by stations was used, being created five different stations, in which each one corresponded to a relief form. At each station, the groups had 10 minutes to answer the questions proposed in the researcher's guidebook that was given to each student. For this, they had the help of *Wakelet* (Figure 2), in which they had, as in the script, the questions, and the links that helped them to answer, organised according to each type of relief. After the allotted time, the groups switched to the next station, and all the groups went through all the missions, in order to get to know the five landforms. With this moment, it was possible to see that ICT are tools that enhance the implementation of active methodologies and, consequently, reinforce learning in students, perceptible through the reasoned and coherent answers given by them.

Afterwards, each group developed an infographic about one of the relief forms, in the Piktochart application (Figure 3). Since there were five forms of relief explored, and there were only four groups, besides that the application

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used was new to the students, it was decided to elaborate in large group an example of the infographic of one of the forms of relief, so that everyone could understand how to work with that tool and clarify any doubts that might arise. Effectively this proved to be an important strategy, because it allowed students to understand how to use that application, and then it was easier, in a small group, to work independently.

Then, the working groups built their infographics, concluding with the presentation of the work to the class, revealing an ease in mobilising the learned concepts.

Figure 3.

One of the works made by the students in the Piktochart application.

Source: own elaboration.

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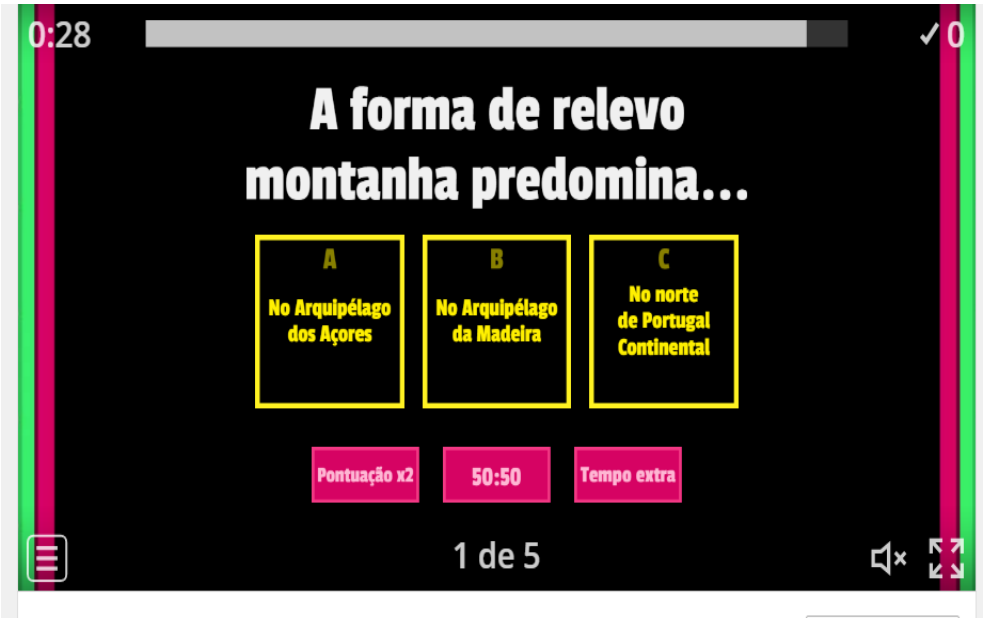
Figure 4.

Consolidation activity in Wordwall.



Source: own elaboration.

As a way of consolidation, at the end, students once again used the resource that accompanied the whole learning unit, the *Wakelet*, and accessed the links provided with proposed activities, interactive activities, such as the use of the *Wordwall* platform (figure 4), which allowed students to consolidate and simultaneously perform their self-assessment of learning, providing multiple learning experiences (Neto & Lopes, 2017).

In a later moment, *Wakelet* appeared again as a guide for students to explore some typical Alentejo expressions and address gender and number in the name, allowing them to access links and content needed to explore the agenda, as well as to address fractions and their reading, finding in this application some mathematical problems and exercises.

As a way to consolidate what they were working on, in the scope of Mathematics, the students accessed Wooclap and performed a challenge related to fractions, namely their reading and ordering, through association and ordering challenges. This choice was due to the fact that this application allows, besides brainstorming, the performance of exercises, so that

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students consolidate their knowledge and at the same time perform a self-evaluation of it, but through a pedagogical strategy focused on playfulness, i.e., of a more dynamic and participatory nature, which leads to a high level of involvement, motivation, commitment and greater willingness to learn, factors that influence learning (Dias, 2005).

4.2. "Cont (o) radition Challenges"

The learning unit "Cont (o) radition Challenges" was developed over the course of three days of intervention, so for this article we will only address the dynamics based on the active methodology of rotation by stations. It is necessary to mention that it promoted learning, evoking the "learning to live together" advocated by Unesco as one of the fundamental educational objectives for the 21st century (Franco et al., 2002).

Using the *Wooclap* app (Figure 5) the student answered two questions, idea cloud style, being "What is a traditional tale? What traditional tales do you know?."

Figure 5.

Brainstorming through the Wooclap application.

Source: own elaboration.

This prior knowledge explained in the mural created in the app led to an open and guided dialogue, where the student shared knowledge related to the concept of Heritage already covered, as well as perceived that the words he/she organised in the initial challenge were connected with traditional tales of his/her knowledge.

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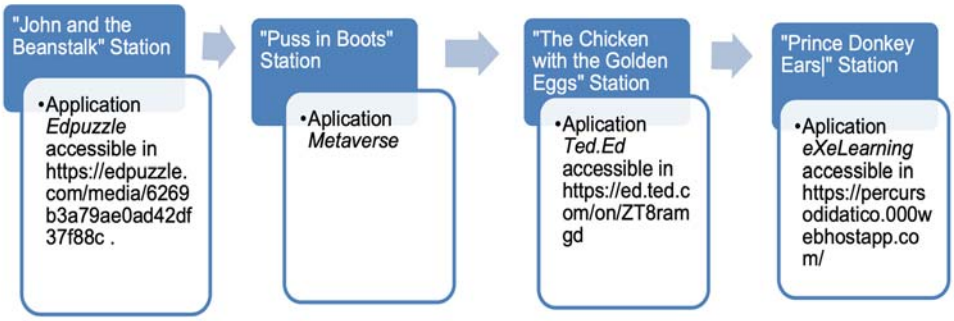
We proceeded to a pedagogical action that was based on the active methodology of rotation by stations (Morin, 2018). At the station "John and the Beanstalk" the student, on a computer, performed an exercise of actively listening to the tale set to music and, in the "Story Explorer's Guide" filled in the textual gaps of the lyrics. Next, in the *Edpuzzle* application he answered several questions about the short story. The "Puss in Boots" station allowed the student to contact the traditional written tale, promoting a moment of reading, comprehension, and interpretation. After this moment, the student, using a digital device, read a QrCode and accessed the *Metaverse* application, an augmented reality app. This was followed by the station "The Hen of the Golden Eggs" designed for the exclusive use of ICT as a way to "learn about computational tools and understand how they are used" (Educação, 2015, p. 3). The student accessed the video from the *Ted.Ed* app that allows online lessons to be provided, with directions, videos, and questions of various kinds. In the app he/she found a video that initially played the music from the story and the student, in the script, erased the wrong word in the lyrics. Next, he would listen to the reading of the short story and answer the questions that were presented in the next section.



The fourth station "The Donkey-eared Prince", like the station "Puss in Boots" developed the reading, comprehension, and interpretation skills by reading and interpreting the traditional tale using the book. When finished with the textual and paratextual questions, the student accessed the *eXeLearning* app and organised the sequence of events in the tale.

As a form of consolidation for the student and formative evaluation for the teacher, the student received a QrCode from the *Plickers* application, already known by the class, and answered questions by positioning his/her code according to the letter of the option he/she considered correct.

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4.3. An (in)conclusion

In the action developed using the *Zoom* platform, as a videoconference platform, it mediated the participation of families in the classroom. It is important to mention that at the time of the dress rehearsal of the dramatizations, a moment was provided to bring parents closer to the school. We sent an invitation to the parents, and they entered the videoconference watching the dramatizations and perceiving the dissemination of the intervention project developed.

V. Data Analysis

Briefly, it is listed that with the use of the digital tools explained there was a positive change in the student's behaviour, to the extent that they did not get distracted, did not talk in parallel, socialisation was orderly, interest and participation were promoted, leading to learning, perceptible through the use of the applications, the answers given, and the verbal interactions. In addition, the need to perceive the receptivity of the tools used, as well as the methodology adopted, is also mentioned. In the first instance, it is possible to point out that the students expected the developed actions, questioning when they would take place, what we would do, and if we would use electronic devices (tablet and computer).

Throughout the sessions, in moments of reflection with field notes and photographic records, we perceived that digital literacy was being promoted in accordance with the selected contents and that, throughout the sessions, the students' digital skills were evolving, as evidenced by the use of different tools within the same category and the students, without explanation, perceived how they had to respond. The initial use of tools they knew, such as *Padlet*, and the evolution towards more advanced software, *Wakelet* and *eXeLearning*, promoted the development of the student's digital skills and an evolution of their computational thinking.

5.1. Organization of ideas: Wooclap

In terms of using *Wooclap*, it allowed the students to visualise their answers on the board as they were answering, allowing them to receive immediate visual feedback of what they had done, and everyone to observe all the ideas. This caused excitement and motivation in the students, who constantly wanted to see the cloud of ideas created, helping their visual memory. This is also a user-friendly application, similar to others of the same category, and the students themselves were able to perceive this idea, visible through

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some of their statements, such as "This application is similar to the Mentimeter that we already use" (statement from a student).

Furthermore, it allowed students, through sorting and association challenges, to consolidate, once again, their knowledge in a more playful and enjoyable way for them. They were very enthusiastic and receptive to this application, and their enthusiasm and willingness to repeat the challenges was visible through direct observation. It also proved to be a tool that enhances formative assessment, allowing us to perceive the knowledge acquired by students, in addition to providing a self-evaluation to them, since the feedback on the task performed is immediate.

This application also has advantages in that it allows the teacher to create more interactive content that he or she knows will motivate students as they learn and/or consolidate their knowledge, allowing a variety of activities and not falling into the trap of using similar strategies.

5.2. Content creation: *Piktochart* and Metaverse

The use of the Piktochart application for the development of infographics allowed students to organise the information they had researched into a single visual image, also serving as a form of evaluation of what they had been working on, and the different groups showed ease in using this application, after a previous explanation and demonstration, showing, once again, the important role of the teacher as a mediator in the teaching and learning process (Papalia et al., 2001). It should be noted that, in general, the groups worked collaboratively, and showed ability to organise themselves, and the children with greater ease helped the peers who had more difficulties, acting in their ZPD (Coll et al., 2001; Papalia et al., 2001).

Later, with the presentation of the infographics, there was a moment of co-building knowledge, while systematising and consolidating it, since all groups had investigated all forms of relief. This was also a formative evaluation of the activity because students showed they had understood and acquired knowledge about the relief forms, and then knew how to share them with the rest of the class and also to answer correctly to questions posed by the cooperating teacher.

All these activities provided learning moments, both in the area of Environmental Studies, in the Nature domain, with the distinction of relief shapes, as well as in Portuguese, with oral expression and writing and planning, both in writing and speaking, and allowed the development of areas

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of PASEO skills, namely languages and texts, information and communication, personal development and autonomy, aesthetic and artistic sensitivity, and body awareness and control (Educação, 2018; Martins et al., 2017). In this sense, it is noticeable that ICT are tools that enhance the development of active learning strategies that allow the promotion of knowledge articulation.

The *Metaverse* application and, consequently, the representation of reality through the most varied media, is of interest to the student, however, with the use of the computer, these representations can be made in virtual form (Lopes et al., 2019). Augmented reality falls within the realm of virtual reality and serves as a complement to the real world by coexisting real and virtual physical objects in the same space as the real world (Forte et al., 2008). This system is considered complementary to the world, contributes to learning and understanding elements of reality, and its use is possible in many different areas of knowledge due to its wide applicability (Lopes et al., 2019).

With this pedagogical experience of augmented reality, the student consolidated the knowledge acquired in the course of reading and interpretation of the text and grammar, as well as contacted with an innovative and differentiating digital resource. In addition, it promoted motivation, interest and active participation in learning. Throughout the experience provided, the students stood next to the virtual animal taking pictures and said they had never used something similar. Later, when evaluating the action, this application was referred to as "the most fun" and the one they would like to use again.

5.3. Communication and community: *Zoom*

Through direct observation of the students and their families, it was possible to perceive the interest and motivation triggered by the videoconference moment. Some students mentioned that their parents were watching them and were happy that they could see their dramatisation, the result of their effort and dedication. Other students mentioned that "This video conferencing platform is the one we use in the quarantine sessions", regarding the SARS-COV-2 pandemic moment, and previous knowledge was perceptible, because they already knew its functionalities and how to use it. Thus, this moment was enriching for the class, as they felt encouraged and supported by their families, feeling that, despite their inability to be at school, they were present in some way. The school-family relationship should be promoted and healthy because the student is between the two and

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the active participation of parents promotes the student's appreciation and involvement (Sarmento et al., 2009).

5.4. Evaluation and Gamification: *Edpuzzle, Ted.Ed and Plickers*

The use of *Ted.Ed* and *Edpuzzle*, Gamification tools, with identical charisma, enable a dynamic learning method. In the video, it was possible to go back to the part of the video where the answer was in case they had difficulties. The use of these digital tools with guided and interactive activities with immediate feedback allows the student to satisfactorily develop their listening and audiovisual skills (Lousada, 2019). Moreover, the student proved to be motivated and persistent when he/she perceived the possibility of stepping back to answer, as well as being referred to as a different app, but equally fun.

In turn, as an evaluative method, *Plickers* favours a dynamic evaluation method, where the student instantly perceives the assertiveness of their answer and makes it possible to gauge the level of understanding they had achieved with the previous active methodology. Likewise, during the activity, the student was attentive, motivated, and interested, and there was no leaving the room, interruptions, parallel conversations, or deviations from focus (Gomes et al., 2017).

From the perspective of the trainee teachers, the Assessment and Gamification tools mentioned above allow for the development of diversified, differentiating and interactive practices as well as dynamics where the student is active in his/her learning. In addition, it is possible to evoke the use of an instantaneous assessment method, valuing student learning and allowing students to develop their digital literacy, to the extent that they are able to understand, select and use the information they have received.

5.5. Content Management*: eXeLearning* and *Wakelet*

The use of the *eXeLearning* application, with a sequence task, promoted reading comprehension after reading the text in a comprehensive way, given that the information contained in it was only accessible through the use of other personal strategies for organising the information collected through reading (Viana et al., 2018). This had already been used previously, with the use of several features that it allows and at the time of this action its employment was facilitated and only presented one activity. However, several students reported that it was easier to use the app with only one activity. It should be noted that, in both usages, the application was exported

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to the website and used, thus, more easily. It should be noted that the tool was easily manipulated by the trainee teachers, its programming being more complex, but the organisation of a learning unit can be completely accomplished in it. Moreover, it allows the teacher to apply diversified dynamics, of different characters and with different purposes, using only one tool.

With regard to the use of *Wakelet*, it should be noted that this application is similar to *Padlet*, in that it allows for a clear organisation of the content, both horizontally and vertically, being easy for students to perceive and manipulate, ultimately giving them greater autonomy, as future teachers took on the role of mediators and students were at the centre of their learning (Barbosa, 2013 as cited in Bernini, 2017). A previous explanation was necessary, since it was a new application for the students, which also required the teachers to research about it, its potentialities and how it works. The students were very receptive to this APP, and it was visible at some point, through direct observation of the pair, their autonomy before the application, and the vast majority did not require guidance from the teachers to find the desired content. In addition, *Wakelet* is a resource that allows for the creation of a common thread to the class so that it is articulated among themselves and enables students to situate themselves in the class itself.

VI. Conclusions

The use of ICT and the employment of several applications, during the study, leads us to conclude that these provided not only the children but also the trainee teachers with motivating, playful and creative moments, in which learning was present and perceptible, especially in the moments of formative and summative assessment that were carried out, both by the trainees and by the class teacher. Moreover, it allowed the understanding that digital literacy (particularly with regard to working with technological equipment and digital tools and the consequent development of digital skills) is likely to be promoted across all curriculum areas, depending on the teacher's pedagogical intentionality, allowing a flexible management of the curriculum.

Moreover, it is important to reflect on the future of ICT in education, trying to perceive the path that, in our view, there is still to follow. As Larroca (2013, p.1) states, the school is not only the one that exchanges analogical for digital, "it is, above all, a new conception of what to teach (...), how to teach (change in methodology), with what to teach (varied teaching resources, mainly technological) and what to develop (new skills)" so that, at the end of

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the student's academic career, he or she will be "a person able to work in this new economic panorama and act in this new social and political context".

In turn, education has much to benefit from ICT; however, it should not be seen and used as an end, but as a means, where the teacher maintains his role as a mediator in the student's learning process (Ribeiro, 2011). The school must rethink education with technology, insofar as it is essential to define objectives correlated with the formation of the student as a being who is part of an information and communication society, starting with the awareness that ICT is essential in the construction of the knowledge society (Fonseca & Escola, 2018), as it was effected and found during the analysis that ICT allows the promotion of student learning.

Likewise, teacher training should compete for the emerging needs in the 21st century, needing to be modified and adapted for the use of digital tools. For a coherent training, it was necessary that digital be present throughout the training, based on interdisciplinarity and the relationship between theory and practice. Training should aim at building knowledge about ICTs and understanding why and how to integrate them into practice, which is fundamental for the development of digital literacy in students (Neves & Pontarolo, 2021).

According to Quadros-Flores & Raposo-Rivas (2017), the inclusion of ICT, as was evident throughout the pedagogical sessions explained, imposes new knowledge, new skills, ways of teaching, of relating, of living the school and peer relationships. These are present in students' daily lives and the school and teachers are challenged to implement a new pedagogical paradigm based on the metamorphosis of the concept of learning where technologies are present in the classroom (Quadros-Flores & Raposo-Rivas, 2017).

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CHAPTER 8. NEW REALITIES ON TOURISM STUDIES TEACHING: BRIDGING THE VR GAP BETWEEN RESEARCH AND PRACTICE BASED ON EMPIRICAL EVIDENCE

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I. Introduction

The Virtual Reality (VR) technology consists of "using a computer-generated 3D environment, that the user can navigate and interact with, resulting in real-time simulation of one or more of the user's five senses combining visualisation, immersion as well as interactivity" (Yung & Khoo- Lattimore, 2019, p.2).

As VR gains interest in several sectors, the number of applications and implications in the tourism activity also increases, as well as their significance. This includes issues such as planning and management, marketing, entertainment, accessibility, heritage preservation as well as education. However, there is still a significant gap between research and practice concerning VR tourism- based utilities given the need to adapt the

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current academic curricula related to Tourism Studies (Loureiro et al., 2020) so that future tourism professionals can take advantage of these VR potentialities.

On the other hand, academic literature states that integrating VR technology in Tourism Studies teaching increases the efficiency of knowledge building and thus cultivates students' comprehensive professional qualities, capabilities as well as abilities (Wei, 2021).

Regarding this, the main goal of this work aims at bringing empirical evidence along a VR- based experimental teaching experience. This experience provided Tourism Studies alumni with a virtual experimental space to enhance its operational functions within the current academic curricula and the fulfilment of the future needs that the tourism sector will demand from future professionals in both public and private sector.

To achieve the goal of this research, a pioneer teaching initiative has been conducted including VR technology for a total of 102 students in a high education institution from undergraduates in Tourism, combining practical applications of VR based on a multidisciplinary approach: tourism management and planning, tourism marketing as well as tourism economics.

A questionnaire was applied to measure the evaluation of VR technologies to guarantee the development of a series of comprehensive professional qualities, capabilities and abilities so that the professional performance of these students meets with the future requirements of the tourism sector.

This research brings practical implications and suggestions for knowledge building in high education institutions as a means of bridging the gap between research and practice of VR integration in the tourism sector.

II. Theoretical approaches and literature review

Digital transformation is a reality that has become embedded in all processes of society (Muwani et al., 2022). The constant growth of technology makes convergence channels are established in a fluid way between the usual processes of life and the new scenarios that already start from a digital content. Thus, society participates in digital resources that are responding to the demands made and the needs and concerns that arise. In response to this fact, one of the digital tools that has been introduced is the so-called Virtual Reality (VR) defined by authors such as Lopreiato et al. (2016) as "Simulations that use a variety of immersive, highly visual, 3D characteristics to replicate real-life; virtual reality simulation is distinguished from computer-

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based simulation in that it generally incorporates physicañ or other interfaces such as a computer keyboard, a mouse, speech and voice recognition, motion sensors, or haptic devices" (p. 40).

The scientific community shows the diversity of VR applications in different fields, where there is a perfect conjunction between science and technological development, raising new realities, from psychology (Díaz and Flórez, 2018), medicine (Ávila-Tomás et al., 2021), architecture (Martínez, et al. 2021) and in education (Begazo, 1999). In addition, it is helping, not only to acquire knowledge, but also to become imbued with it (Bower et al., 2020; Luo et al., 2021).

Based on these contributions, an analysis is established according to three key factors to that support the progress of VR in the training processes applied to education; the first is the technological development of the institution, in this case it is estimated the degree of commitment and interest that the centre has for the application of technology in the training processes of its educational community and, on the other hand, the degree of digitization of the management processes of the centre itself. The second factor is the digital competencies and skills of teachers, where the new "technoeducational" paradigms require teachers to have a certain level of digital competencies (López, et at., 2019). These competencies and their application in the processes of teaching and learning that have VR as a tool are still extremely limited. In some cases, the introduction of training innovation projects is motivated by educational research that, with inter-administrative support, is helping to introduce changes in the training processes of teachers and students. Finally, the third factor is the development of content and technological tools that make possible VR-based initiatives contribute to the achievement of the proposed educational objectives.

In this context, the model of a digitised higher education defines a competitive university that thrives in improving education by developing technological habits, also oriented to be dynamic and motivating education (Barrera & Guapi, 2018). Thus, we see an example in the impact of simulators with VR in learning that become, as a training tool, an experience to the student of great value and significantly increases learning outcomes (Mariscal, et at. 2020). In addition to this, one of the main challenges of VR is the challenge of creating didactic content for VR that involves, beyond the student and the teacher, the need to have specific equipment to generate such content to achieve the desired learning outcomes. It is also necessary to have the necessary tools to ensure optimal immersion, which entails costs

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(glasses, audio helmet, gloves, etc.) that can limit its use as a training tool. In any case, these limitations will not put an end to what authors such as Cabero and Barroso (2018) point out as a pedagogical change in the way of teaching that is fostering real experiences and activities focused on deeper and more interactive learning.

Regarding Tourism Studies, it is important to note that the tourism sector is undergoing a revolution brought about by the introduction of technology, including VR, which will have a great impact on tourism operations as it will help in the marketing of experiences (Alonso, 2019). This fact encourages a rapprochement between tourism and VR as it is one of the most powerful technologies to be applied along the whole value chain of destination, and thus, with a high potential in high education as well (Fan & Wang, 2012; Liu et al., 2020; Wei, 2019, 2021).

From this perspective, this chapter will present three case studies that aim at bridging the VR gap between research and practice in Tourism Studies.

III. Practical experience / Empirical experience

3.1. Sample of the work

The sample of this work contains a total of 102 undergraduate students of the Tourism Studies area. Specifically, 39.2% of the students were enrolled in the course on Planning of Sustainable Tourism Spaces; as well as 60.8% of the students were enrolled in Commercial Management and Tourism Marketing (30.4% of the sample) or Organization and Business Management courses (30.4% of the sample).

3.2. Questionnaire design and data collection

A questionnaire was designed to measure the evaluation of VR technologies to guarantee the development of a series of professional qualities, capabilities and abilities so that the professional performance of these students meets with the future requirements of the tourism sector. This questionnaire contains a total of 21 items based on a 6 points Likert-Scale, where 0= Strongly disagree and 5= Strongly agree.

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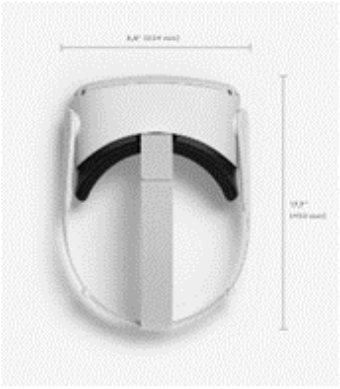
3.3. Used resources based on VR-technology

The following resources were necessary for the development of the VR-based activities:

• Glasses: Meta Quest 2. Thanks to the six degrees of freedom technology, these glasses track the movements of both the head and the body and integrate them into the virtual reality with realistic precision. No external sensors are required. The virtual glasses have a fast-switching LCD display, a resolution of 1832 × 1920 resolution in each eye and a supported refresh rate of 90 Hz (figure 1).

Figure 1.

VR glasses: Meta Quest 2.



Source: own elaboration.

• Spatial.io. This application recreates an office where people gather around a table and discuss different topics. It can be used by people in different geographical locations and recreates the feeling of being in the same physical space. The application allows the use of various tools, such as sticky notes to sort the information.

• Google Earth. This application allows you to travel and learn about the world with a virtual globe. You can view satellite images, maps, terrain, 3D buildings, among others. Google Earth images include information available from a wide variety of providers, including public, government and commercial sources.

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• A compatible computer from which the computer applications can be controlled and an expert in this type of virtual device can monitor the smooth running of the activity.

• Two practice rooms. In one of them, the virtual experience is conducted individually. In the other, group discussion and reflection on the activity conducted takes place.

3.4. Commercial Management and Tourism Marketing through VR-based learning

The practice has been conducted as an activity of the subject Commercial Management and Marketing corresponding to the 2nd year of the Degree in Tourism. The contents and competences of this subject refer to the marketing tools taught by the universal teaching community, that is, the "4Ps" of Marketing: product, price, communication and distribution.

Thirty students participated in the practice and the duration of the course was 6 classroom hours, to which must be added the non-classroom work at home.

As will be explained below, the students are organised into discussion groups and conduct a group reflection on the experience carried out.

The main objective of this activity was to describe and explain the marketing strategies conducted by establishments located in Sierpes Street in Seville (Spain). For this purpose, a virtual visit to the street was conducted, during a determined time and individually. It should be noted that Calle Sierpes in Seville is a pedestrian crossing where many of the major national and international brands and other local establishments are mixed. It is the most important and well-known shopping street in Seville. It should also be emphasised that the virtual experience cannot be carried out inside these establishments since the application used, Google Earth, does not have permissions to access them, so the practice is based on the information that students can view virtually walking down the street.

The activity/practice took place at the end of the course period, at which time the students have acquired most of the knowledge and skills.

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3.4.1. Developed skills and competencies

Students who successfully completed the internship worked on the following competencies:

- Capacity for analysis and synthesis.
- Organisational and planning skills.
- Computer knowledge related to the field of study
- Information management skills
- Proactively manage their learning process in the field of business management.
- Plan and develop innovative actions in the professional practice in the field of commercial management.
- Possess and understand knowledge of Commercial Management that is supported by textbooks with some aspects involving knowledge from the forefront of their field of study.
- Differentiate the commercial function in the company.
- Know and use different marketing strategies:

  o Pricing strategies.

  o Product strategies.

  o Distribution strategies.

  o Communication strategies.

- Communicating information, ideas, problems, and solutions in the field of commercial management in an adequate and effective way.
- Solving commercial case studies in work teams.
- Use commercial terminology in a correct way in the realisation and presentation of works and projects.

3.4.2. Milestones of the activity

A total of four phases were developed within this activity (figure 2):

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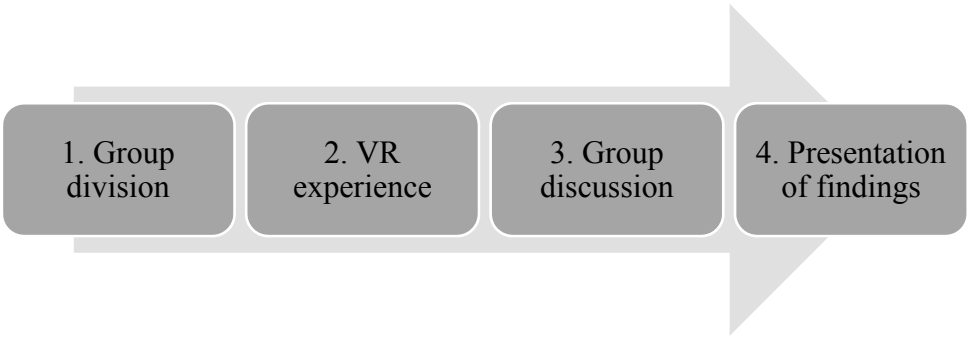
Figure 2.

Milestones of the course on Commercial Management and Tourism Marketing through VR experience



Source: own elaboration.

1st Phase: Group division: The group is formed by 30 students divided into 10 subgroups of 3 students. The teacher should try to form the subgroups as homogeneously as possible, taking into account the theoretical contents already taught.

2nd Phase: Virtual experience. Each student develops his experience individually in the room provided for this purpose, having 10 minutes to observe and tell his experience to the other students in his group who will accompany him taking the notes they consider necessary for the resolution of the practice.

3rd Phase: Group discussion. After each student in the group exhausts his viewing time, the whole group will go to the classroom for discussion and reflection of the virtual experience. The duration of this phase is 30 minutes.

4th Phase: Presentation of findings. In this phase each subgroup of students will carry out the practice by detailing in writing the different marketing strategies observed virtually. It was carried out in a non-presential way, and the task will be delivered online through the Virtual Campus to be corrected by the teacher.

The development of this practice has led to a series of improvements in the teaching/learning process. Firstly, the students have connected with a technology tool such as VR, for which they are properly prepared, although not well trained. Secondly, the teachers have used a reality that, although

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virtual, is more real than the one developed with traditional tools, so the incorporation of these new tools seems essential.

Another key aspect for the formative development of the students is the increase in their organisational and planning capacity, both at the individual and group level, since the practice requires a very didactic reflection both in its execution and in its exposition. For his part, the teacher participates in the experience more as an observer guide than as a traditional teacher, which is an incredibly positive professional incentive.

It should also be emphasised that the teaching innovation materialised with the VR glasses is something simple to apply in this subject, marketing. In fact, the marketing teacher finds a more friendly and pedagogical space to explain the contents of this subject by developing his practices with students in a virtual environment.

Finally, although the applications of VR are being especially important in different areas and sectors, its implementation and development in the tourism sector is especially noteworthy because of the relationship it currently has with the experiential marketing strategy.

3.5. Organization and Business Management through VR-based learning

The activity is associated with the subject "Organization and management of companies" at the first year of a Tourism degree, specifically, with the subject of decision-making in the area of human resources.

Thirty students participated in the activity, divided into three groups of ten members each. Each group had a total duration of three hours: one hour of individual preparation, one hour in the virtual classroom and one hour of group discussion. Each group conducted the activity in the virtual classroom separately, but the subsequent group discussion was held jointly.

The aim of the activity was to evaluate the usefulness of a virtual office as a tool for business decision-making between people in different geographical locations.

To this end, a script was provided for the simulation of a business situation in which a decision had to be made. The proposed scenario is an event organisation company from the Region of Murcia that after five years of experience decides to open a branch in Madrid to expand its market. To do

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so, they have to hire a person responsible for this new office. The tasks to be conducted and the qualifications and skills required are explained in the practice statement and the profile of three candidates is presented. The students in the virtual office represent a meeting of the human resources area of that company in which they have to identify the pros and cons of each of the candidates, distinguish their hard and soft skills and choose the most suitable candidate.

The activity was carried out at the end of the second term, after having taught the theoretical contents related to this subject, when the students have acquired most of the knowledge and competences.

3.5.1. Developed skills and competencies

Students who successfully completed the activity worked on the following competences:

- Analysis and synthesis skills.
- Computer skills related to the field of study.
- Information management skills
- Proactively manage their learning process in the field of business decision making.
- Identify the hard and soft skills of a personal profile
- Evaluate the suitability of a job profile for a job position
- Communicate effectively and appropriately information, ideas, problems and solutions in the field of human resources.
- Use business terminology correctly when conducting and presenting work and projects.
- Establish constructive dialogues for decision-making.
- Reach consensus in business decisions
- Leading decision making
- Working in a team
- Evaluate and value the opinions of others

3.5.2. Milestones of the activity

A total of three phases were developed within this activity (figure 3):

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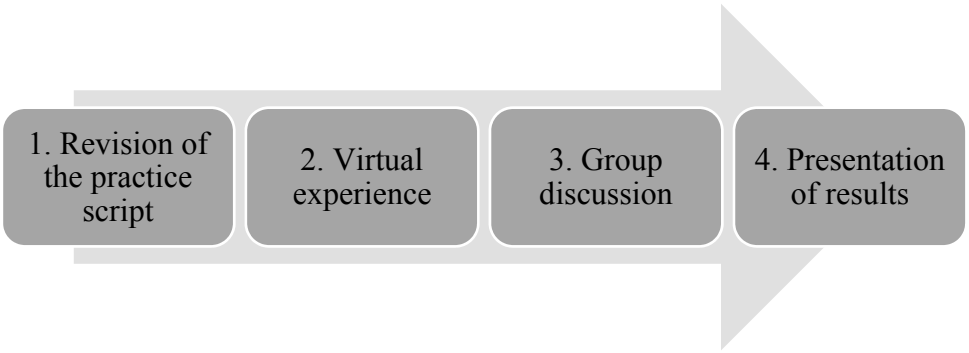
Figure 3.

Milestones of the course on Organization and Business Management through VR experience



Source: own elaboration.

1st Phase: Review of the practice script: The practice is prepared individually; the students received a documentation with the instructions of the activity they had to simulate in the virtual environment, and they worked on it individually.

2nd Phase: Virtual experience. Three groups of 10 students were formed and they entered the virtual office where they discussed the three profiles set out in the statement. This phase was developed in three stages. In the first stage, sticky notes were used to indicate the pros and cons of each candidate in order to assess their suitability for the job. The second stage was a process of discussion and sharing of the opinions of each participant. And in the third and final stage, the process of dialogue and agreement for the final decision was worked on.

3rd Phase: Group discussion. After doing the virtual activity, the students met with the lecturer to discuss their experience. Among other aspects, they talked about the advantages and disadvantages of using this tool.

4th Phase: Presentation of findings. In this phase, the conclusions of the debate from the previous phase were drawn up.

This activity has allowed students to familiarise themselves with a new teaching technology and to assess its applicability to professional activities. The use of VR has allowed them to work in an environment and under conditions that are difficult to reproduce in a traditional classroom. The scenario in which they have worked is closer to a real work situation and is

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more stimulating for them than some traditional teaching techniques. However, this motivation comes, in part, from the novelty of the tool and the extraordinary nature of its use in the training process.

During the experience, each student had to manage a complete function of the company and had to reach a consensus on a decision. In this way, in addition to practising the knowledge of the subject, they were able to develop and understand the importance of some soft skills such as overview, teamwork, capacity for dialogue and consensus and problems solving.

Globalisation and business offshoring mean that these types of applications are increasingly used and are seen as a tool that will proliferate to facilitate business decision-making.

3.6. The Planning of Sustainable Tourism Spaces through VR-based learning

This practice has been conducted as an activity of the subject Planning and Management of Sustainable Tourism Spaces of the Degree in Tourism, focusing mainly on the basic notions of sustainable strategic planning. A total of 40 students participated in this activity with a duration of 3 hours.

The main goal of this activity consisted of analyzing a specific touristic space planning by a fieldwork. Thus, the students are divided in groups of three to select any national or international tourism site so that a holistic planning analysis can be conducted.

A total of eight virtual fieldworks were made along Latin America, Asia and the Pacific and Europe, so that several case studies could be visited through Google Earth and VR gadgets. The teaching instructor led these fieldworks so that students can detect the weaknesses and strengths related to the planning model of the studied sites.

3.6.1. Developed skills and competencies

Students who successfully completed the activity worked on the following competences:

- To analyse the economic dimension of tourism.
- To understand the dynamic and evolving nature of tourism and the new leisure society.

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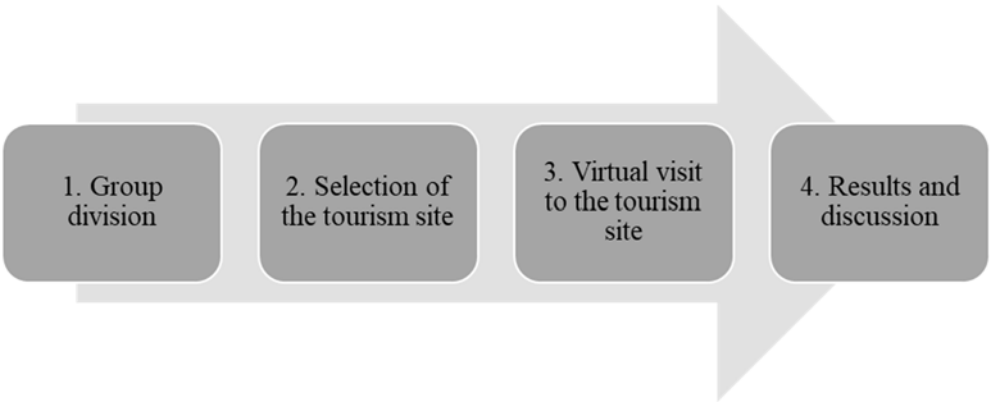
- To know the main political-administrative structures of tourism.
- To convert an empirical problem into an object of research and to draw conclusions.
- Manage the tourism territory in accordance with the principles of sustainability.
- Understand the functioning of destinations, tourism structures and their business sectors at the global level.
- Know the objectives, strategy and public instruments of planning.
- Detect technical planning needs of tourism infrastructures and facilities.
- Analyse the impacts generated by tourism activity.
- Know the main initiatives for the enhancement of cultural heritage.

3.6.2. Milestones of the activity

A total of three phases were developed within this activity (figure 4):

Figure 4.

Milestones of the course on The Planning of Sustainable Tourism Spaces through VR experience



Source: own elaboration.

1st phase: Group division. Each group should have among 2-3 students so that the tourism planning analysis can be conducted from a multiple point of view.

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2nd phase: Selection of the tourism site. Each group must select one tourism site to be analysed. This is one of the most important facts of the activity, as the students should assure that the chosen tourism site really represents the characteristics related to the corresponding destination.

3rd phase: Virtual visit to the tourism site. A series of VR-based fieldworks are conducted in each one of the selected tourism sites. Each experience will be led by the responsible group.

4th phase: Results and discussion. Each group will share the main characteristics associated with the chosen tourism site while using a VR-gadget in a common screen. Also, an alternative VR-gadget is shared among the other students so that they may share the same virtual space as the leading group.

From a geographical point of view, this activity enabled to prove how global remoteness could be treated with a VR solution so that several extreme cases related to tourism spaces can be directly addressed along a virtual fieldwork. Also, giving the students the chance to reconsider VR technology as a useful and necessary tool for several purposes regarding the contents of this course.

IV. Results

The results of the questionnaire suggest that there is a significant and positive effect of VR-based technology when it is applied on Tourism Studies teaching (Table 1):

Table 1.

Results of the questionnaire about VR-based teaching on Tourism Studies

Ítems	Mean
1. The visual stimuli provided by VR systems are appealing to users.	4.90
2. The interaction through VR contributes to a better learning of the subject as opposed to the use of a classical teaching methodology.	4.87
3. Time passes faster for me while consuming content through the VR system compared to consuming content through standard 2D displays	4.85

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4. Introducing VR in the classroom turns learning into entertainment.	5.00
5. Throughout the learning process, it is necessary to apply theoretical knowledge to practical VR examples to develop new skills and capabilities	4.70
6. Through the simulation and experience provided by VR, students will continue to explore and investigate educational content.	4.70
7. VR develops students' creativity	4.92
8. With the help of virtual reality, a student can learn how to react in certain (unfamiliar) situations.	4.85
9. The possibility to see and experience the different places in the world inside the classroom provided by VR can inspire students.	5.00
10. Virtual environment models teach and train as effectively as reality.	2.00
11. While using a VR system, I feel like I am present in a virtual world.	4.62
12. I feel that shared group experiences in a shared virtual environment are important.	4.73
13. The use of a VR system distracts students from the educational content.	4.88
14. I find it difficult to understand abstract content and concepts without a visual representation of them	4.47
15. Assessment through VR activities is more representative of the knowledge acquired by the students, compared to traditional assessment methods	4.76
16. I believe that my interest in courses and educational content would be greater if interactive content and VR systems were used.	4.86
17. In subjects that incorporate VR, the teacher is the main source of information and interaction.	4.65

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18. By using VR systems, students can actively learn and participate instead of passively looking at 2D screens.	4.67
19. The use of VR can encourage an inclusive and multicultural environment.	4.92
20. I believe that VR can enhance the proliferation of online and distance learning.	4.21
21. VR encourages the development of skills and abilities necessary for my future career in the tourism industry.	5.00

Source: own elaboration.

VR based technology proves that this kind of learning initiative makes the learning process more entertaining and attractive (items 1, 2, 4, and 13), as is creativity (item 7).

Inspiration and connection with other places, cultures and environment (items 11, 12 and 19) as a group experience also contribute to build knowledge between all the members of the groups so that knowledge gaps are solved collectively as a combination of weaknesses and strengths of each student.

At the teaching level, the preparation and development of the practice does not involve complex work for the lecturer; on the contrary, the lecturer, who acts as a mentor (item 17), has an easy-to-use tool that allows him/her to broaden the scope of his/her training work. Although the software used can be improved in terms of the possibilities offered to the users.

Also, findings suggest that students tend to disagree that VR-based teaching is similar to traditional methodologies (item 10). Thus, these kinds of initiatives are unconsciously demanded by students not only to better understand and apply the theoretical concepts (items 14 and 15), but also for the development of skills and abilities that are necessary in their professional future (item 21).

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V. Conclusions

The development of these learning initiatives has led to a series of improvements in the teaching/learning process in the Tourism Studies courses that these initiatives were integrated into.

Firstly, the students are connected with a technology tool such as VR, for which they are properly prepared, although not well trained. Secondly, the teachers have used a reality that, although virtual, is more real than the one developed with traditional tools, so the incorporation of these new tools seems essential.

Another key aspect for the formative development of the students is the increase in their organisational and planning capacity, both at the individual and group level, since the practice requires a very didactic reflection both in its execution and in its exposition. For his part, the teacher participates in the experience more as an observer guide than as a traditional teacher, which is an incredibly positive professional incentive.

It should also be emphasised that the teaching innovation materialised with the VR glasses is something simple to apply in any Tourism Studies subject, as teachers found a more friendly and pedagogical space to explain the contents by developing the practices with students in a virtual environment.

Finally, although the applications of VR are being especially important in different areas and sectors, its implementation and development in the tourism sector is especially noteworthy because of the relationship it currently has in areas such as tourism and business organisation, marketing and/or destination planning and management.

VI. Acknowledgements

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CHAPTER 9. FLIPPED CLASSROOM APPLIED AS A LEARNING MANAGEMENT TOOL IN UNIVERSITY TEACHING

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I. Introduction

Since the SARS COV 2 pandemic, educational institutions have migrated from face-to-face classes to digital education.

In Mexico, this was a challenge since, according to data from the National Institute of Geography, Statistics, and Informatics (INEGI, 2022), the Internet user population reaches 81.6% in urban areas and 56.5% in rural areas, so not all people have access to digital education.

In the School of Administration of the Benemérita Universidad Autónoma de Puebla, a distance education system was implemented in March 2020 to face the pandemic. Professors and students were migrating digital education from face-to-face classes. This strategy means the opportunity to continue their university studies and take the corresponding semesters.

Data from Columbia University and presented by Blackboard at the BBWorld conference in 2012 showed that teachers speak around 200 words per

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minute, while students only remember around 100. In the traditional knowledge model, students remember only 70% of what is said in the first 10 minutes of class but only 20% of what is said in the last 10 minutes; according to these data, students only remain attentive for about 40% of the time a class lasts. This information shows a clear need to change the traditional learning model to new trends (Tourón, 2015).

Given this scenario, the researchers of the present study applied various tools to engage students in their learning and achieve more encouraging results.

After putting the tools into practice, one of them was more successful than the others, the so-called flipped classroom.

The methodology of this pedagogical approach is based on the inversion of teaching-learning activities. Outside the classroom, the student's work is to prepare to learn through exercises and videos related to a specific topic. Subsequently, the teacher uses class time to resolve doubts and practice through exercises; the "homework" is done in the classroom, with the guidance and support of the teacher, and the "exposure of the topic" is learned before class. (Wasserman et al., 2015).

The results section shows a comparison between the learning experiences in the fall semester of 2021, and the efficiency of the flipped classroom model was verified through experimental research.

II. Theoretical approaches and literature review

The flipped classroom is one of the most appropriate proposals to respond to the educational demands of today's society following the pandemic, by SARS COV 2; in which distance education became the optimal option to avoid contagion and continue teaching classes.

In this methodology, the teacher does not restrict his participation in the classroom to a simple transmission of knowledge, instead; he has the role of transmitting, facilitating, guiding, and supervising learning, promoting student participation and collaborative learning (Martín-Aizpuru & Díaz-Bravo 2021).

Through the flipped classroom, the student is allowed to be the protagonist of his learning, avoiding the traditional role where the student learns passively, does not investigate, and is left only with the information given by his teacher. This strategy also motivates the students to do additional

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research, inquire about various ways to solve a problem and verify the knowledge acquired in the teacher's company (Sun & Lin, 2022).

Sun & Lin, (2022) define the flipped classroom as a methodology where the teacher redesigns his class; so that his students work both inside and outside the classroom; through proposals such as previous readings, questionnaire solutions, review of critical points. The purpose is that the student arrives prepared to the classroom and can solve doubts and specific tasks with the teacher's support. Integrating technologies such as videos that can be consulted from the Internet is part of the strategies used in flipped classrooms.

One of the main advantages of this methodology is that students can watch the class (video) as often as they require; in this way, learning is personalised and through the resolution of doubts and exercises in class, with the teacher's support, to absorb new knowledge. In this way, the teacher changes the traditional teaching methods, avoids the wear and tear of repeating the same topic several times, and adapts to the learning pace of each student, using interactive communication and discussion that manages to interest the student more, since the doubts arise before and during the classes and not after them (Li, 2015).

There are different versions of the origin of the term flipped classroom, Tourón & Santiago, (2015) mention that it was used in 2000 by Lage et al., as an inverted classroom (IC) and was used to explain the class strategy implemented in a specific subject of Economics. Specifically, it refers to the use of techniques in which the teacher requests an intuitive approach to specific topics, prior to class work.

While Bishop & Verleger (2013), cite Walvoord and Johnson Anderson as the pioneers of the concept; in 1998. An important fact is that the authors agree that this strategy's innovation brings the student closer to the class content prior to it.

The principal purpose is that during the time in the classroom, analysis and problem solving can be performed instead of a professor who exposes a topic, engaging the student in active learning.

The main difference with the model proposed by Bergmann & Sams (2012) is the use of technology (video conferences) to access support material outside the classroom. Thanks to YouTube, Bergmann and Sams' videos became popular and Flipped Learning Network was created.

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Many teachers worldwide have made and continue making digital content, with tutorials at all educational levels, which are available to anyone with internet access. The challenge for students and teachers is to discriminate between a world of information and find truthful and proven information, despite all the content available on Web 2.0.

It is still recommended that the teachers develop their videos by themselves and do activities to adapt the flipped classroom methodology.

According to Bergmann & Sams (2012), the pillars of the flipped classroom are:

- **Flexible environment**: teachers must understand that each student learns at their own pace; therefore, it is impossible to have structured thinking; what works for some students may not be helpful in different contexts. Therefore, patience and adaptability to the conditions and characteristics of the group are essential elements.
- **Learning culture**: the flipped learning model focuses on the student; this does not mean less work for the teacher. On the contrary, the professor must carefully plan the approach activities, make videos, propose exercises and solve doubts. The time in the classroom is used more efficiently to explore the topics with greater depth, and the students actively build knowledge, thus generating meaningful, humanistic, and constructivist learning.
- **Intentional content**: teachers should become facilitators of student learning, preparing material that allows them to synthesise, analyse, and deepen the topics to generate a better conceptual understanding.
- **Professional teacher**: professional teachers continuously observe their students, providing feedback at each stage, evaluate fairly, and clarify doubts, even allowing/generating controlled discussion and debate, respecting the diversity of their students' points of view.

Among the disadvantages of the flipped classroom model is the lack of motivation that students may show towards the pre-class "intuitive approach" stage. Getting them to understand the need to perform previous activities and come to the classroom without preparation can take time and effort. In this case, the teacher must be patient and implement tactics to engage students in the topics developed (Aguilera-Ruiz, et al. 2017).

An important note is that implementing this methodology requires more effort from the educator since he/she needs specialised equipment to make professional videos, optimal facilities with good lighting and external noise

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proof, and training to use technologies such as Youtube, among others. (Aguilera-Ruiz et al. 2017).

III. Practical experience / Empirical experience

In the case of the Management School, classes were taught synchronously through Google Meet or Blackboard Collaborate so that students could participate through chat or audio. Google Classroom, Blackboard, and Moodle were used to access academic resources such as anthologies and videos, as well as for the delivery and completion of assignments, exams, and participation in forums.

By recording synchronous classes, students could review the contents of a topic or class at home in an autonomous manner.

Upon identifying the theoretical benefits of the flipped classroom, the authors of this chapter decided to implement experimental and mixed (qualitative-quantitative) research to verify the efficiency of the implementation of the flipped classroom in the subjects of Menu Planning and Administration.

Four study groups were used; the first two (A and B) had subjects with the following characteristics:

- Students of the bachelor's degree in Gastronomy of the Faculty of Administration of BUAP.
- Studying the subject of Menu Planning.
- In both groups, the same professor taught the subject.

In both experimental groups, the research was conducted with the topic: of menu engineering, in which mathematical formulas are applied to classify the dishes of a restaurant and determine sales strategies. The difference was that the topic was explained in a traditional form in group A. The topic was presented in the virtual classroom, and then a case study was left as homework. While in group B, the professor prepared a video before the class, and each formula was explained step by step. Then, the students were asked to watch the video and write down their specific doubts, and later, in the virtual classroom, the doubts were solved, and they worked on the same case study applied to group A.

Group B always had the explanatory video at their disposal (they could watch it as often as they considered necessary).

In contrast, the students in group A only had access to their class notes.

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Groups C and D had subjects with the following characteristics:

- Students of the bachelor's degree in Business Administration, Faculty of Administration of the BUAP.
- Studying the subject of Administration.
- In both groups, the subject was taught by the same teacher (it should be noted that it was a different teacher than in groups A and B).

In both experimental groups (C and D), the research was conducted on strategic planning. The students should understand the SWOT analysis, in which an administrative model is applied to analyse the micro and macro environment of the company and then make combinations to generate differentiation strategies to obtain competitive advantages. The difference was that the topic was traditionally explained in group C class. In group D, the teacher prepared a video prior to the class, which explained step by step the SWOT methodology, its classification tools, and its characteristics. The students were asked to watch the video and write their specific doubts; later, in the virtual classroom, the doubts were solved. They worked on the same case study applied to group C. Group D always had the explanatory video at their disposal (they could watch it as many times as they considered necessary). In contrast, group C students only had access to their class notes.

At the time of the feedback and evaluation of the exercise, the following quantitative findings were found:

Table 1.

Comparative chart of flipped classroom effectiveness

Group	Class type	Students number	Percentage of students who correctly solved the exercise
A	Traditional	33	45,5%
C	Traditional	27	44,4%
B	Flipped classroom	35	82,8%
D	Flipped classroom	30	83,3%

Source: own elaboration.

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Several methods are used to evaluate the effectiveness of learning. (Mekonnen, 2020).

Exercises of the Menu Planning class were considered "correctly solved" if all the dishes were classified according to their characteristics of popularity and profitability.

In the Administration class, exercises were considered "correctly solved" if they contained at least five strengths and weaknesses and five threats and opportunities classified correctly.

As can be seen in Table 1, in the experimental groups in which the flipped classroom methodology was used, more than 80% of the students solved their exercises correctly, compared to the other two experimental groups, which achieved 44% effectiveness. It is important to emphasise that the experiment of groups A and B were realised by a different teacher from groups C and D, so the success of the flipped classroom methodology can be proven, no matter which professor participates in the experiment.

After the quantitative analysis of the methodology's effectiveness, the researchers applied a six-question questionnaire to the students.

After an extensive review of the literature related to flipped classroom methodology, the study's authors designed this questionnaire.

The instrument's main objective applied anonymously to the students was to gather information about their experiences working with flipped classrooms, so it was only applied to students in groups B and D.

The findings are presented using descriptive statistics based on frequency counts and percentages:

- 90% of the students mentioned that the video designed by their teacher motivated them to attend class.
- 86% considered that they could solve their exercise correctly, thanks to the fact that they had the video at their disposal to watch it as many times as necessary.
- 75% of those surveyed indicated that this new way of learning facilitated the construction of their self-learning. Doing the exercise during class helped them resolve their doubts and find their mistakes on their own.
- 75% of students mentioned they felt less frustrated when a topic was explained to them previously, and they had the support of their

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teacher during the elaboration of their tasks (contrary to what happens with the traditional model).

- 50% of the study subjects mentioned that this methodology increased their connection and trust towards their teacher.
- 48% of the students emphasised that they felt less stressed, and that collaborative learning was fostered since they learned by listening to the doubts of other classmates.

Therefore, as mentioned by Martín-Aizpuru & Díaz-Bravo (2021), the three most valuable aspects of the flipped classroom are to encourage independent study, to learn progressively, and to acquire content in the long term.

This research shows that the use of the flipped classroom requires a change in the paradigm of the traditional role of both students and teachers.

On the one hand, students need to engage in pre-class activities, develop research discipline, and become interested in the topic of study.

Teachers must provide well-designed, playful materials and be constantly trained to use new technologies.

The exercises that educators propose in the classroom should promote reflection and challenge students with exercises of a degree of difficulty that generates doubts and communication among peers. Likewise, the teacher should be a facilitator during the class and be available to clarify doubts and support the student's learning process.

It is essential to provide post-class follow-up to the methodology through enriching activities that strengthen the knowledge acquired in the classroom. Gamification through tools such as Kahoot, Mentimeter, and EducaPlay (available in free versions) can encourage students to continue learning in a non-traditional way.

According to Al-Samarraie, et al. (2020), the flipped classroom methodology can be used transversally in different subjects and learning contexts in higher education, from teaching exact sciences to history, philosophy, or, as in this case, economic-administrative areas.

Based on the teaching experience, the steps followed by the researchers to apply the flipped classroom methodology are shown in figure 1 and are explained by points.

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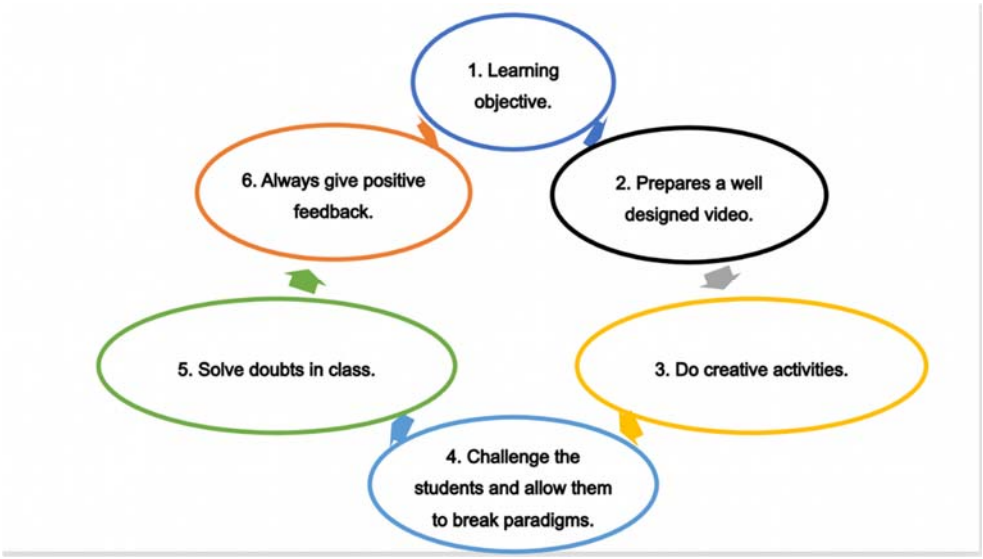
Figure 1.

Steps to apply the flipped classroom methodology.



Source: own elaboration.

- 1. Be clear about the learning objective.
- 2. Fully master the topic, summarise all information, and in the lecture/video, provide data from other authors/links to research (help your students to find valuable data).
- 3. Professors must prepare activities, record the class or at least record a summary. Use technology and be as creative as they can.
- 4. Present activities that challenge the students and allow them to break paradigms and be disruptive. Teachers would respect the rules and enforce them.
- 5. Solve doubts in class; in this methodology, the classroom is the space to "do homework," "presenting challenges, and it is the moment when teachers are going to help their students." Do not "sit back and watch or move on to other activities."

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- 6. Always give positive feedback; when learning, the ideal is to make mistakes, practice, practice, practice, and practice until the students master it.

IV. Results

As shown before, the efficiency of the flipped classroom model consists of redirecting attention toward personalised learning and adapting to the characteristics of each student.

The efficiency of the methodology was verified through the experimental study, which consisted of comparing study subjects with homogeneous characteristics.

As already explained, each pair of groups, objects of observation, were taught the same material, and the same topic was explained to them; the only difference was that in one, the traditional methodology was applied, and in the other, the flipped classroom. To verify the efficiency of the model without the teacher's influence, the study was conducted with two different teachers; that is, it was applied to 4 groups.

There was an increase in terms of better learning results compared to the groups in which a traditional model was applied, regardless of the teacher or the subject.

In addition to the above, the qualitative research showed satisfactory results in class dynamics for students and teachers. (Angadi, 2019)

Today's educators must remain at the forefront and use various tools to enhance the development of student competencies; it is essential to adapt information technologies to innovate in the classroom. The needs and the current context of the new generations of students demand a more flexible attitude than before, and it is a fact that active teachers motivate students; there will always be new ways of transmitting knowledge.

For some teachers, implementing the flipped classroom is complicated due to the innate characteristics of the model.

As mentioned before, it requires the teacher to dedicate additional time to diagnose the group, adapt the model to each student's needs, prepare a video, design relevant activities, implement classroom strategies, and evaluate the learning outcome.

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However, teachers can start by implementing the flipped classroom in the most challenging topics of each subject's curriculum. Once the more difficult topics or with a higher failure rate have been identified, teachers can improve the efficiency of the transmission of knowledge by applying this methodology. (Sánchez, 2017)

The flipped classroom is complemented and enriched using information technologies since it is through these that more creative and ludic content can be designed to obtain the students' attention.

Blended learning, for example, can be understood as the subsequent model of a flipped classroom since it involves a combination of online tools and classroom instruction. Further studies are suggested to investigate this methodology to prove its effectiveness.

V. Conclusions

This research arose from the need to implement effective learning models, within the framework of migration presential to online classes, in the face of the SARS COV 2 pandemic.

Given a scenario in which it is more difficult to capture the attention of students, methodologies pedagogical as the flipped classroom promote the incorporation of technologies in teaching; to generate more efficient learning processes.

The flipped classroom model has been the subject of various experimental studies. Some data recovered from Flipped Learning Network reports that for educators who use the flipped classroom, 67 percent reported increased test scores with benefits for students, 80 percent improved student attitudes, and 99 percent said they would apply the methodology again. (Santiago, 2014)

The flipped classroom is a successful learning strategy. As observed in the current study, there was a 37% increase in correctly solved exercises regardless of the teacher or subject in groups B and D.

One of the main benefits of the flipped classroom is that it can be applied in various disciplines and educational contexts.

The results of this study show that the use of the methodology promotes the active participation of students and fosters a commitment to learning.

Likewise, peer interaction and student-teacher communication are improved when this methodology is used.

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When applying the flipped classroom, one factor that most encourages students is being able to repeatedly watch a class (through a video made by their teacher); the video also reduces the stress of learning new topics and allows them to "prepare" before class. (Nwosisi, et, al. 2016)

Teachers must understand the flipped classroom methodology before applying it, as it presents advantages and challenges and can be used differently with all students.

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CHAPTER 10. DIDACTIC STRATEGIES GEARED TOWARDS A VIRTUAL ENVIRONMENT IN THE COURSE "BIOLOGICAL BASES OF AESTHETICS" FROM THE DEGREE IN TECHNICIAN IN INTEGRATIVE AESTHETICS.

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I. Introduction

Due to the pandemic's impact, Chile's education system was forced to modify and adapt itself to a completely virtual methodology in 2020. Teachers had to take on a brand-new teaching method at a distance in order to support their students and create activities that fostered learning, all with the intention of having the same effect as face-to-face classes. However, if online teaching is not implemented and conducted in the correct way, it can create an opposite effect or even cause a sense of rejection within the students (Bustos and Coll, 2010).

According to Cabrero (2007), one of the disadvantages of this teaching model is that it requires technological competence from both the teacher and student. The teachers need to develop skills that allow them to efficiently conduct a class using technology while the students need to be prepared to study independently. On the other hand, virtual classes can diminish the quality of the information given to students if there is not a positive relationship between students and teachers. Without proper communication between both parties, the quality of education can decrease.

The degree in Integrative Aesthetics, taught in "Los Leones Professional Institute," has classes that are taught mainly in a "practical way." One of these classes is biological foundations with the goal of acquiring basic knowledge

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of anatomy that in the end contribute to the practice of activities related to this speciality. Although this class is theory-based, practical activities are conducted using concrete models which help link theory with practice. However, due to the pandemic restrictions, this element of the class has been difficult to conduct. One of the first steps was to compile opinions from the students and teachers through a focus group. With them, an action plan for the design and implementation of a workshop with ICT tools was established along with active teaching methodologies to support the job of teachers and complement the theoretical contents. This should offer students a closer look at their future professional career, enhancing the meaning of what they have been taught while at the same time developing skills, motivation, and interest in what they've learned. In turn, this is what becomes responsible for enabling learning in order to make further progress towards the intended goal.

II. Theoretical approaches

A ten-session workshop proposal was developed that includes active participatory teaching methods for topics that were considered the most important or key in each unit of the class. Furthermore, a manual to guide teachers in the implementation of these activities was designed taking into consideration the specific learning outcomes of each unit (Delgado and Solano, 2009).

When sharing this workshop with teachers and the heads of the department of the degree, the innovative proposal and positive effects it could bring under the new teaching method were positively evaluated. Only minor modifications were made that related to the wording of the manual. Regarding the activities, they can be conducted without any special material or equipment. In this way, the aim is to ensure that participants do not need to incur unnecessary expenses to take part in the workshop. Furthermore, this is to safeguard not only what they will learn but their health and the health of their families.

The structure and design of the manual was intended to support the job of the teachers with the implementation of activities and the use of ICT tools. These tools allow students that are taking the Biological Foundations of Esthetics course to have an active and meaningful learning experience, one that facilitates the understanding of the content. In addition, it generates a continuous desire for students to improve their classroom practice as well as an opportunity for self-reflection and growth.

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The manual is composed of an introduction that informs the teacher about the material, the objective of this innovative teaching method, and the benefits of its application. Moreover, teachers will find definitions and explanations regarding the use of ICT tools along with the proposed workshop strategy that can be developed in class. In addition, it informs teachers about the materials and resources that both they and their students should have.

To complement this, the workshop activities are designed to develop critical thinking, analysis, synthesis, evaluation, and judgement in students while they conduct tasks that require them to apply the knowledge they have acquired. All of this is with the final goal of making sure students take something away from the course, which in turn facilitates the learning process in each of their courses (Camacho et al., s.f.).

The workshop was designed in ten sessions with each one focusing on what was considered by the teachers to be the most relevant material in each unit of the class (Pimienta, 2019). The objective of the manual is to guide the teachers in the implementation of each of the activities. It has been designed to mimic the structure of the class, with a beginning, an implementation stage, and a conclusion. At the beginning, students are informed of the class objectives that are expected to be achieved in the session and during the learning experience. In addition, there is a brief recap of the topic that will be addressed. During the implementation of the class, the planned activity is conducted and designed in order to comply with what's expected during the learning process, while in the conclusion a summary of what's been learned is presented. The manual details step by step what the teacher should do and how to guide the students during the activity, as well as the resources required to properly carry it out. The teacher who is in charge of guiding the activities will conduct demonstrations that the students will then have to replicate, thus associating the theoretical contents with the practical ones. Furthermore, questions are asked during the session in order to encourage the students to analyse the situation and provide possible solutions. The ten workshop sessions complement each of the units that make up the course syllabus. In each one of them, a didactic activity is conducted which is the most appropriate, according to the contents that are going to be studied.

In the case of the first three sessions, a project-based learning strategy is applied in which students must prepare the material in advance that will be the base of the work done in each session. This method seeks to have students put into practice the knowledge they have learned in a more "real" way while they complete the requested material.

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In the workshop, the teacher will ask the students to present their material in order to provide solutions to the questions posed. They should be able to answer questions using the material they came prepared with along with the input from their classmates. This teaching method fosters collaborative learning and gives it a greater meaning. It also establishes a closer connection with what they learn to the real world. Students explore their own interests, share their talents, and develop planning, communication, creativity, and innovation skills.

In the third session, to close the first unit, a generative topic strategy is used which allows for the assimilation of the contents through dealing with a challenge given by the teacher. Students work in groups, in this case through Zoom, with work rooms created for each of them so that they can discuss and organise the challenge at hand together. Once the allotted time has run out, the teacher brings all of the students back to the main room to share their results. The students then have to make contributions and justifications with respect to the topic in order to reach a joint solution. The questions posed should be about the anatomy and physiology of the skin using what has been discussed and learned previously in class. Students should establish connections with what they could observe in a patient. They can use their notes or search for important information on the internet in order to substantiate their approach.

In the fourth, fifth, and sixth sessions a guided activity strategy is used. In this case, it will be conducted individually where the students must follow the instructions given by the teacher at the beginning of the class. A demonstration will also be made that the students will later have to copy. In addition, a discussion of what has been observed will take place and the students should complement their answers with those given by their peers. This teaching approach allows for a better understanding of the contents and processes studied by following the steps made by the teacher and associating them to a real-world context. In this particular case, these sessions deal with how the musculature of the human body functions in different circumstances. The application of this strategy is simple when using technology and can be used in a variety of situations. It allows students to actively be involved in their own learning process which fosters the development of critical thinking, among other skills.

Finally, for the last four sessions, a Problem-Based Learning strategy is implemented in which students become the protagonists of their own learning. Moreover, the acquisition of knowledge has the same importance as the acquisition of skills and attitudes which is of vital importance in health

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because they will have to provide patient care in their professional careers. Furthermore, this strategy favours critical thinking and aids in the development of problem-solving skills by having to integrate and apply the contents through simulations of real-world situations or problems.

III. Hands-on-experience

Here a qualitative study approach was employed that seeks to make higher education innovative as well as strengthen the competencies and quality of the learning experience for students. The project was carried out in the Biological Foundations of Esthetics course in the Integrative Esthetics degree at Los Leones Professional Institute. This course takes place during the first semester of the students' first year.

Within the research process it is possible to distinguish the following stages:

- **Teacher analysis of student performance, their adaptation to an online teaching method, and the methodologies applied during the course**: The main concerns of the teachers who teach the course were adapting the course contents to an online method and the strategies needed while at a distance. Due to the nature of the course contents, the students had some difficulty in understanding and applying them. This concludes that the teaching methods that were originally used are no longer effective in these new conditions.

- **Analysis of the students' development during the class regarding the online teaching method and the strategies used by the teachers to cover the different course contents**: Students mainly express concern and uncertainty when it comes to online teaching since they don't know much about it nor are they experts when it comes to online learning. The critical points that were identified were the following: difficulty with integrating the theoretical content with practice, lack of understanding and comprehension of the course (which leads to a decrease in attendance), participation, and motivation during the class.

- **Designing a workshop for the Biological Foundations of Esthetics course that favours student learning and active participation**: The workshop has been designed in 10 sessions, each one focusing on the topics that were considered by the teachers to be the most relevant in each unit of the course.

- **Elaborating a teacher manual that promotes using didactic strategies for active teaching in virtual environments for the Biological**

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Foundations of Esthetics in the Integrative Esthetics degree: The manual is intended to guide teachers in the development of each of the activities. It has been designed in such a way that the workshop mimics the structure of a class with a beginning, an implementation stage, and an end. At the beginning of the workshop, students are informed about the objectives of the session that the teacher hopes to achieve as well as the way in which they will work during the session. Furthermore, the teacher gives a brief overview of the topic that will be addressed in that particular session. The manual details a step-by-step plan of what the teacher should do and how they should guide the students during the activity in addition to outlining the resources needed to carry them out.

- **Evaluating the students' and teachers' perceptions of the strategies that were used in the workshop and in the teaching manual:** When the proposal was presented, it was positively evaluated by all of the participants. This means that, thanks to their opinions and suggestions, the relevant revisions were made in order to generate a final version of the project, thereby fulfilling the proposed objectives.

IV. Outcomes

In order to make an analysis, the teachers who taught the course were asked about the content that they considered the identification and comprehension of the musculature of the human body to be the most complex content in the course. This is mainly due to the amount of content, the complexity of the names of the structures, and the ability to identify them on a person's body. Secondly, the course deals with esthetic alterations. These require integration of the course content with a physical evaluation which can be complex for those who have never had prior experience working with patients. Finally, the anatomy and physiology of the skin, along with the names of the structures, presents difficulties due to the fact that each of its layers behaves independently.

Regarding the change of teaching method, most of the teachers stated that the change to a virtual method made it more complex for students to understand and master the contents taught in the classes. It also decreased their participation and motivation.

As for the students, all of them identified a lack of previous knowledge regarding the subject matter which caused them trouble. It also intimidated them since they perceived the contents as difficult to learn and deal with. In regard to the virtual teaching method, the students expressed concern,

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mainly due to the fact that the contents require hands-on learning to achieve better comprehension. Online teaching does not always achieve the same objectives nor comprehension on the part of students which means that the activities require careful planning. This is so that the students can have a classroom experience as close to the real thing. The workshop was designed in the following manner considering the background information obtained (Figure 1).

Within the teaching manual, each session has a structure that facilitates the work of the students and, regardless of their previous experience, the guiding teacher should be able to carry out the class without any problems. By following the steps in the manual for the activities, teachers can tie together the classes and material. This manual is a guiding tool and aid for the teacher as it gives recommendations for each part of the activity and encourages student participation. It not only seeks standardisation in terms of carrying out each class, but it also offers tools to optimise the students' learning process.

The survey used in order to determine the degree of student satisfaction with the workshop had a positive impact on all of the students who participated. More than 50% stated that the supporting material not only facilitated their understanding and assimilation of the contents, but that it also provided an opportunity to use their imagination and creativity to share the information with their family members who often participated as well and ended up learning about the subjects involuntarily. The following graphs illustrate that 80% were satisfied with the activities carried out as part of the proposed workshops (Figure 2).

On the other hand, 100% of the students considered the activities carried out as an important factor that helped them understand the contents of the course. Those results are illustrated in the following graph (Figure 3).

It's worth mentioning that in the initial presentation of the projects, a great deal of creativity was observed. Furthermore, students showed support and empathy towards one another, increasing camaraderie despite never having been in physical contact. Thanks to the group activities, students showed interest and enthusiasm for what was to come in each session of the workshop. This sentiment is reflected in the following graph where 92% of students responded that they would like to do similar activities in the future (Figure 4).

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Moreover, the guiding teacher stated that the use of the manual was especially useful as it provided order and continuity to the activity. This allowed for a better understanding of the objectives and to visualise the proposed activity from the students' point of view. The activity, despite being conducted in a virtual setting and still presenting difficulties to students and teachers alike, was very well received by everyone involved. The following graph depicts the approaches taken (Figure 5).

The changes or modifications that were done by the teachers focused on technology, such as internet connection or equipment for both the teachers and students. On some occasions, this led to modifying the presentation time of the activities in order to be able to complete them in full.

On the other hand, the clarity that the instructions given by the teacher during the workshop activities stands out. 80% express conformity and adequacy of the instructions that the teaching staff used. Those results can be found in the following graph (Figure 6).

The results obtained suggest that the proposal was well received and contributed positively to all the participants in the study.

V. Conclusions

A preliminary analysis of the situation made it easier to identify the points that were critical for designing the project. The needs and concerns of both parties involved were made clear. The main points were focused on the change to a virtual teaching method, the apparent complexity of some of the contents, and the need to carry out activities that could give students real-world experience and prepare them for their professional lives in patient care. Regarding the teachers, they need to have sufficient knowledge to carry out the activities in the best possible way. Given this, there is a necessity to define active participatory strategies, to implement the usage of ICT, and to have the respective teacher trained in these areas, if necessary, in order to achieve the course objectives.

Regarding the development of the workshop activities, simple and common technology and materials that most people have access to were taken into consideration to avoid major implementation costs as well as avoid having the students incur expenses in order to participate in the activities.

The designed activities were focused on complementing the content of each course unit as well as developing skills and competencies that bring students closer to working as future health professionals. This was done through

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active participation and placing them at the centre of the learning process so that they could give meaning to what they were learning. This was successfully achieved, at least in the first session which was implemented up to the date of this report. There was a positive reception by the students, and they expressed enthusiasm throughout the process.

With respect to the creation of the manual, each session of the workshop was designed considering the three main parts of a class: the beginning, the development or presentation of an activity or course material, and the closing. Given this, each session along with the activity has a structure that facilitates the job of the teacher and student regardless of their previous experience. The manual is an aid for the teacher as it gives recommendations for each activity and encourages student participation. It not only seeks standardisation, but it also offers the tools to optimise the learning process. It was necessary to consider the reality of the world of health and specifically focus on the contribution of the Biological Foundations of Aesthetics course in regard to the formation of integral professionals. This was even more so during the pandemic, where teachers and educational institutions in general were trying to make the student the centre of the learning process even in an adverse context. They did their best to accomplish this, which meant that they achieved learning with a meaning, giving personal value to their lives and professional performance.

When the proposal was shared with the course teachers and heads of the department, it was positively evaluated by all of the participants and no changes were made to the design or to the proposed activities.

Finally, in a course such as Biological Foundations of Aesthetics, which requires practical activities, incorporating active learning strategies facilitates the understanding of contents and provides greater dynamism in a virtual environment (Rodríguez, M., 2011). Although it is understood that standardising strategies with the use of ICT tools can be complex due to the different methodologies applied by teachers and the diversity within the student body, the designed proposal seeks to become a contribution to the teaching-learning process. It aims to increase the quality and to provide a degree of uniformity that is consistent with the active participatory methodologies of the course. Make them simple to apply but make them didactic activities. Contextualise them as tools and disseminate them with the support of the teaching manual.

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APPENDIX

Figure 1.

Sessions of the workshop.

SESSION	EXPECTED LEARNING	TEACHING STRATEGY
Sessions 1 and 2: Anatomy of the skin	Differentiate anatomical structures of the skin and its components, along with their functions and locations in the human body	Project-Based Learning
Session 3: Anatomy of the skin	Differentiate anatomical structures of the skin and its components, along with their functions and locations in the human body	Generative topic
Session 4: Muscle anatomy and physiology	Distinguish the locations and functions of the main muscles by analyzing each of their components	Forum
Sessions 5 and 6: Muscle anatomy and physiology	Distinguish the locations and functions of the main muscles by analyzing each of their components	Guided Activity
Sessions 7 and 8: Esthetic Alterations	Identify the most common esthetic alterations through body evaluation in order to establish which of them need intervention using masophylaxy and esthetic massotherapy. Explain morphological and topographical characteristics of the patient's body for recognition in the future regarding the most common esthetic alterations.	Problem-Based Learning
Session 9: Esthetic Alterations	Identify the most common esthetic alterations through body evaluation in order to establish which of them need intervention using masophylaxy and esthetic massotherapy. Explain morphological and topographical characteristics of the patient's body for recognition in the future regarding the most common esthetic alterations.	Simulation
Session 10: Esthetic Alterations	Identify the most common esthetic alterations through body evaluation in order to establish which of them need intervention using masophylaxy and esthetic massotherapy. Explain morphological and topographical characteristics of the patient's body for recognition in the future regarding the most common esthetic alterations.	Case Studies

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Figure 2.

Students' opinions regarding the workshops.

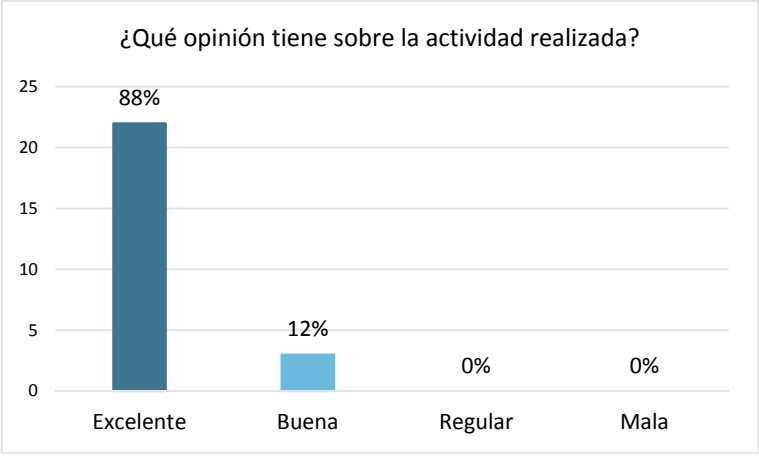

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Figure 3.

Usefulness of the activities.

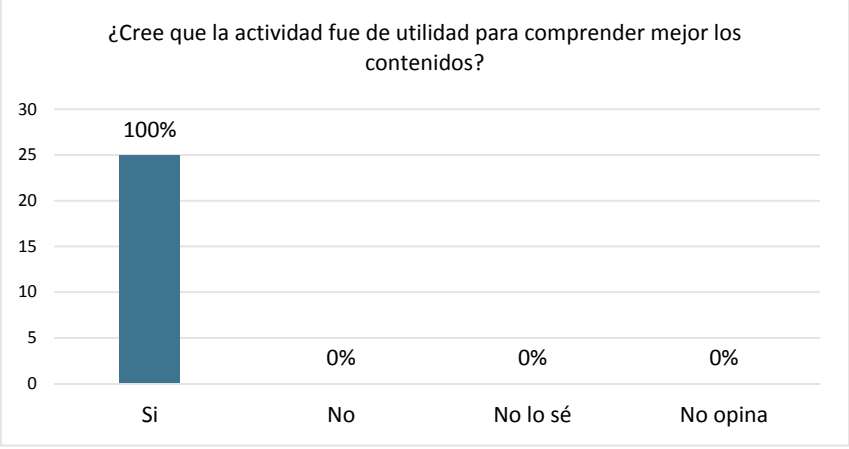

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Figure 4.

Changes in other course activities.

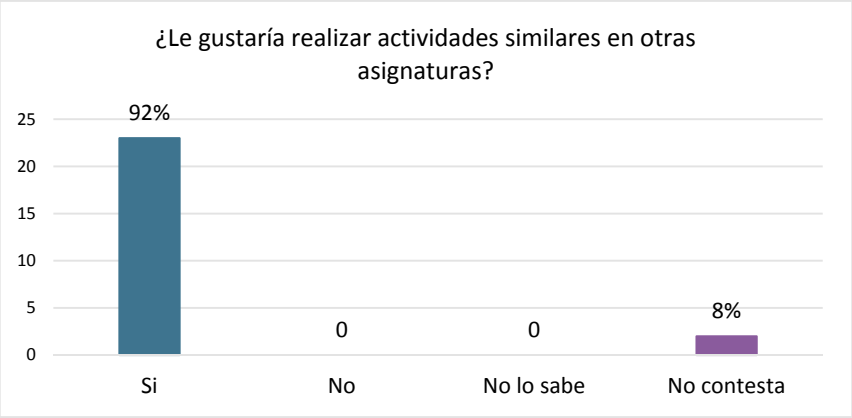

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Figure 5.

Changes or modifications to the activity.

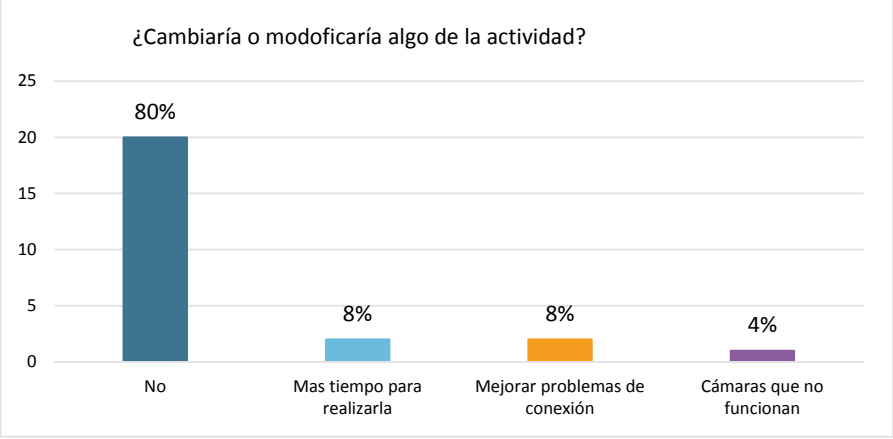

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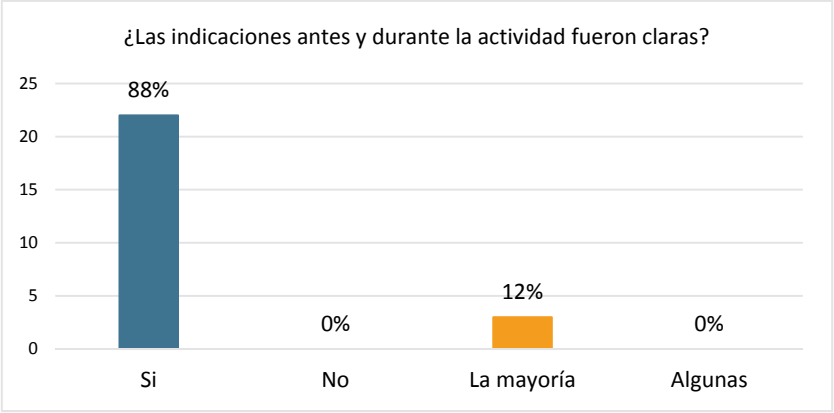
Figure 6.

Clarity of Instructions.



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CHAPTER 11. COMPUTERISED APPLICATION FOR AUDITORY AND VISUAL STIMULI FOR CHILDREN WITH COGNITIVE DISABILITIES

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I. Introduction.

In the world we live in, there are beautiful sounds that come from nature and are created by people, like Mexican music, which is deeply rooted in the hearts of Mexicans because of our cultural heritage. It is important to appreciate these sounds without diminishing the importance of classical music. These captivating sounds have the power to delight our senses and evoke deep feelings in our lives. Therefore, it is crucial to consider those who do not possess this ability, including those who are born without it or lose it at a young age.

By their very nature, children are particularly adaptive learners, leading to intellectual maturity when they are attentive for extended periods of time without distraction. They are also able to tell a story, which is an expression of remarkable language development accompanied by an extraordinary imagination.

In addition, children have more exposure to new technologies which could contribute to growth in almost all areas of knowledge as well as allowing for real-time interactions between the student and teacher. Part of a child's development is having opportunities to express themselves in all areas of growth.

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In this world in which we live one of the most important moments is when one experiences sound. Sound is a determining factor in our lives since we are immersed in it. It affects the safety and security we feel when we walk down the street, and it is a part of our entertainment and enjoyment. It also comprises a third of the senses that are used for meaningful learning in education.

As far as music is concerned, it is fundamental to promote the socio-affective capacities of a child, carrying out activities and games to develop skills in the classroom among classmates and teachers as well as in daily life. These consist of repetition and imitation of sounds that exist in the environment in which a child learns, grows, and creates.

For this reason, a computerised application has been developed for auditory and visual stimuli for children with cognitive disabilities considering the needs for cognitive development.

The following software is available on the market for those with visual impairments: JAWS, Orca screen reader, NonVisual Desktop Access, Super Nova screen reader, Braille Note, and Blazie. Those with hearing impairments can use the following software: Sordo Ayuda, 112 Accessible, MyEarDroid, AMPDA, Sordos Herper, Signslator, ¿De qué hablan?, Wakeaf.

II. Theoretical approach and literature review.

Over time, the social context has been decisive in defining a position on what is perceived as a criterion to differentiate between those who have a disability and those who do not (Seoane, 2011).

A disability restricts one's ability to carry out normal activities, such as limiting or impairing them from performing daily activities such as hearing, seeing, speaking in a natural way, or some common motor activities such as climbing stairs or simply moving around. (Hernández-Ríos, 2015).

Individuals with congenital or acquired disabilities exhibit one or more physical, mental, intellectual, or sensory impairments. These impairments can be either temporary or permanent, hindering their full and effective inclusion and creating disparities compared to the rest of the population (Granados, 2018).

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2.1. Background

The specialised Technical Committee on Disability Information was established in 2011 by the National Council for the Development and Inclusion of Persons with Disabilities (CONADIS) in collaboration with the National Institute of Statistics, Geography, and Informatics (INEGI) to establish the Disability Information System. This system is responsible for collecting and providing data to the National System of Statistical Information and Geography. Its main objectives include developing a methodology, creating technical instruments, and establishing the conceptual framework for the National Registry of Persons with Disabilities (RENADIS). Additionally, it ensures compliance with international recommendations from relevant agencies in the field and the creation of a National Catalog of Indicators from a disability perspective (CONADIS, 2015).

In 2015, in addition to the aforementioned, there was also progress towards the legal recognition of the rights of persons with disabilities when considering Article 1 of the Reformed Political Constitution of the United Mexican States, which raised compliance with human rights to the level of constitutional obligation and in conjunction with the provisions of the General Law for the Inclusive Development of Persons with Disabilities. The main objective here is to guarantee and protect the freedoms with respect and equal opportunities for the full inclusion of persons with disabilities in society, enforcing human rights (DOF, 2022).

The Deputy Directorate General for Attention to Disability was created by the National Human Rights Commission in 2011 in response to the needs set forth in Article 33.2, which was stated in the Convention on the Rights of Persons with Disabilities. Therefore, member states are obliged to create autonomous mechanisms to guarantee and promote compliance with the inherent rights of persons with disabilities, as well as monitoring the proper implementation of the instrument (CNDH, 2018).

At the international level, in 2007 the United Nations held the Convention on the Rights of Persons with Disabilities in Mexico. This convention emphasised the support to protect, guarantee, and promote human rights in conditions of equality in parallel with basic freedoms and dignified respect.

Article 24 refers to education, which makes the guarantee of an educational system at different levels obligatory, meaning that persons with disabilities will have access to these quality educational systems free of charge. These systems adapt to their needs and facilitate their training while providing

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specific and effective methods and strategies to create an environment that supports good educational performance without excluding anyone.

Article 23 stipulates the respect for the rights of persons with disabilities to age-appropriate information, reproductive education, and family planning. The necessary means must be provided to ensure the realisation of these rights (UN, 2021).

In 2014, Mexico submitted a report relating to its compliance measures. The United Nations Committee on the Rights of Persons with Disabilities has issued several statements and recommendations that the Mexican government should address. The main recommendations regarding education speak to the need for an inclusive system at all educational levels from the legislative and political point of view, streamlined through adequate budgetary resources and appropriate teacher training (Granados, Treviño, & Bonilla, 2018).

According to the 2020 population and housing census, there are 6,179,890 people with disabilities in Mexico, which represents 4.9% of Mexico's total population. Of those who responded to having disabilities, 47% of them are men and 53% are women.

By definition, a person with a disability is recognized by INEGI as someone who cannot hear, walk, see, remember or concentrate to communicate, or can perform their own personal care.

Most certainly a person can have more than one disability, so the percentages add up to more than 100%. For example, having a hearing impairment could include some degree of language limitation. Those with cerebral palsy could have some motor and language difficulties as well.

Likewise, as previously mentioned, in the state of Coahuila there are different organisations that aid children, young people, and adults with disabilities (DIF Coahuila, 2020). These organisations work in conjunction with the National Council for the Development and Inclusion of Persons with Disabilities (CONADIS) and its management considers the provisions set forth in the National Program for the Development and Inclusion of Persons with Disabilities 2014-2018 (CONADIS, 2018).

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In Comarca Lagunera, there are three institutions that assist people with disabilities, *Minds with Wings*, Downs Foundation and the Institute of Different Abilities. (ICADI), Map 1, the latter with a population of 30 people with different diagnoses, such as Down Syndrome, autism, blindness, cerebral atrophy, cerebral palsy, and microcephaly to help them coexist in society. The institute divides learning into five stages: Values and behaviour; Crafts, Read/Write, Language and Communication, and Motor Mobility (dance). There is a space in the institution called the "Multisensory Stimulation Center" that is like what classrooms offer and has recreational spaces and workshops which are suitable for integral development.

In Martin (2010), it was mentioned that people with visual, hearing, or motor disabilities, in a large percentage, have a decrease in their intellectual abilities, making their case very particular and therefore difficult to find a tailor-made software to meet their specific learning needs. In this paper, an adaptable software platform for education specific to the needs of each person with disabilities is presented.

Kavcic (2005) talks about how people with disabilities have problems with the use of Information and Communication Technologies. He also points out some lines that should be considered by software developers.

Borblik (2015) argues that multimedia devices could assist in daily activities and improve the quality of life for people with intellectual or developmental disabilities (IDD). She analyses mobile software and proposes features to meet the usability and accessibility of interfaces. She also presents an example of the use of technology for a travel assistant with people with IDD.

III. Practical experience/Empirical experience.

3.1. Analysis of software requirements

Given that new information technologies are updated, it is important that we can use tools that help us in the preparation of better teaching materials that aid students in learning in a more didactic and entertaining way. This type of software could help develop auditory and visual association. It would benefit students from the "Institute of Different Capacities," for example, an institute for students who have different types of disabilities.

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Functions that should be performed by the software:

- Each user must register or log in to the system to use it.
- Registration of two types of users: Administrator users for teachers and normal users for students.
- Registration of a student profile with personal, medical, academic, and family data.
- Record of surveys with questions in different categories (animal sounds, instruments, nature, letters, etc.) with their respective answers to each question.
- Each student will have access to study the lessons of the surveys that are recorded.
- Each student may submit one evaluation of each recorded survey.
- The teacher or administrator user will be able to view the grades of their students, or all the students registered.
- The teacher or administrator user can download a document with the grade of individual or all students.

3.2. Design.

The waterfall methodology is followed to give way to software development. Performing an analysis of the system, implementing the necessary requirements in the software, the design of what is going to be performed, coding the system through a programming language, testing to validate and verify that there are the least number of failures, and subsequently the implementation to perform software maintenance.

A Model-View-Controller (MVC) design pattern is followed, creating a modelling of our database with Entity Framework with the view that the user will interact directly with the model that we have (data and information). Furthermore, there is an intermediary that is responsible for transmitting the information, called the controller, where the views and database model will interact.

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Figure 1.

Diagram of Classes.

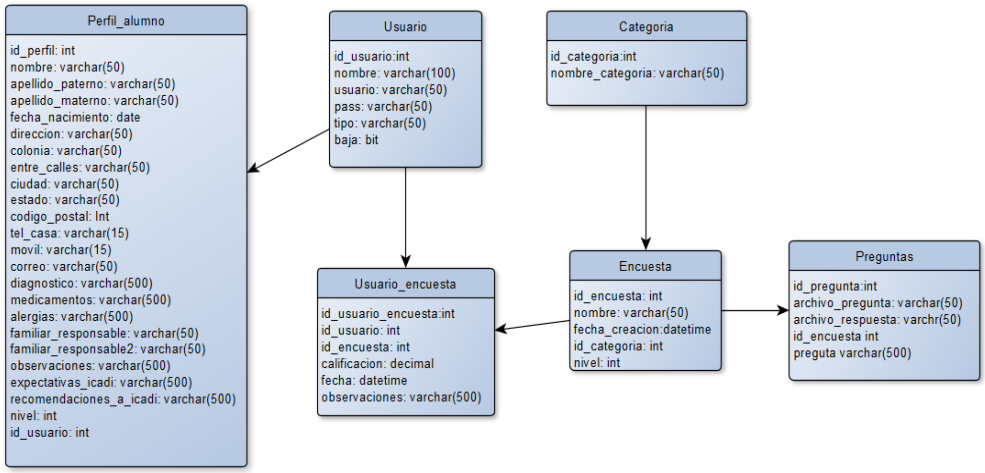

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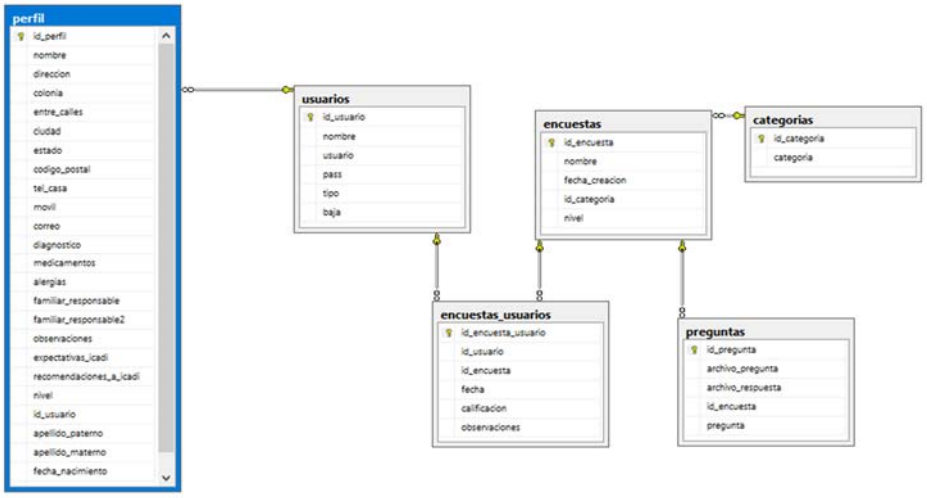
Figure 2.

Diagram of the Database.



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3.3. Coding

The database was created in SQL Server, where we can manage our queries, and the data and records are shown in the corresponding tables (Arévalo, 2017).

The project began with the programming, first defining what each of the views would have to perform and thus carry out the holistic integration in conjunction with the Visual Studio C# programming language (Michelone, 2014).

3.4. Tests

Once the coding was finished, validation tests of the data entered were performed along with user access tests.

3.5. Maintenance

When the software is in production and being implemented, bug fixes are made along with adapting to the user's needs and creating features that the user believes to be pertinent in the software.

3.6. Alternative solutions

For the development of this software, it was decided to use the development methodology based on the waterfall model (Stsepanets, 2021).

3.7. Waterfall methodology

The waterfall methodology is a linear model used in software design which has a sequential processing from the beginning to the end, going through several processes.

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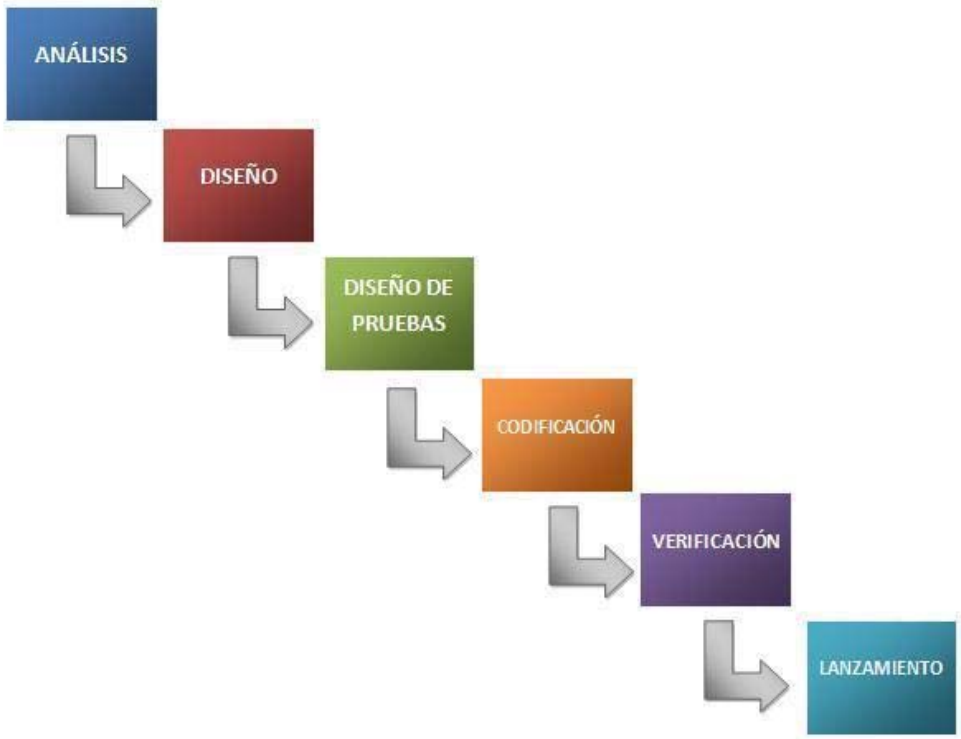
Figure 3.

Waterfall model.



Source: own elaboration.

Application analysis. In this phase, the application requirements are gathered and organised into units or modules.

(a) Requirements analysis. The requirements are defined, encompassing them in the context of the application, the functionality and the required interfaces.

(b) Design. A structure that encompasses the data and its management, the procedures and the interfaces is defined with the purpose of translating what is needed into a model that reflects all of this.

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(c) Coding. The designed model is translated into code that will make the application work.

(d) Testing. During and at the end of coding, pre-established sets of tests are performed to ensure that the application does what is required.

(e) Maintenance. It consists of keeping the released application in use, supervising, apart from that use, additions requested by the client or solving performance problems.

3.8. MVC design pattern.

An option for the development of applications is the Model View Controller (MVC), developed by Microsoft, Co. This methodology or pattern consists of two parts, the data and the application itself, through which the user communicates. The first oversees data management, such as data capture, storage and organisation. The application has two basic functions, the view, which is the interface with the user, and the controller, which contains all the logic of the application operation (Smith, 2022).

Let us provide a broad definition of the components comprising the Model-View-Controller (MVC) architecture.

(a) Model. Structure that contains the way the application operates. It contains the business operation logic, translated into programming logic. It receives the requests for some action through the View and sends it to be processed through the controller.

(b) Controller: It oversees calling the necessary events. For example, responding to a request such as the registration of a dataset, the query of a particular data, or a task requested by the user. The responses are then sent to the View.

(c) View. Visual representation of the model, it has the format to receive requests and deliver results to the user. It is the interface of the application with the user.

The idea behind the Model View Controller (MVC) is to separate the user logic from the system or application internal logic, which is a visual part, where the user interacts, and a controller, which carries out the necessary events to fulfil the required functionality.

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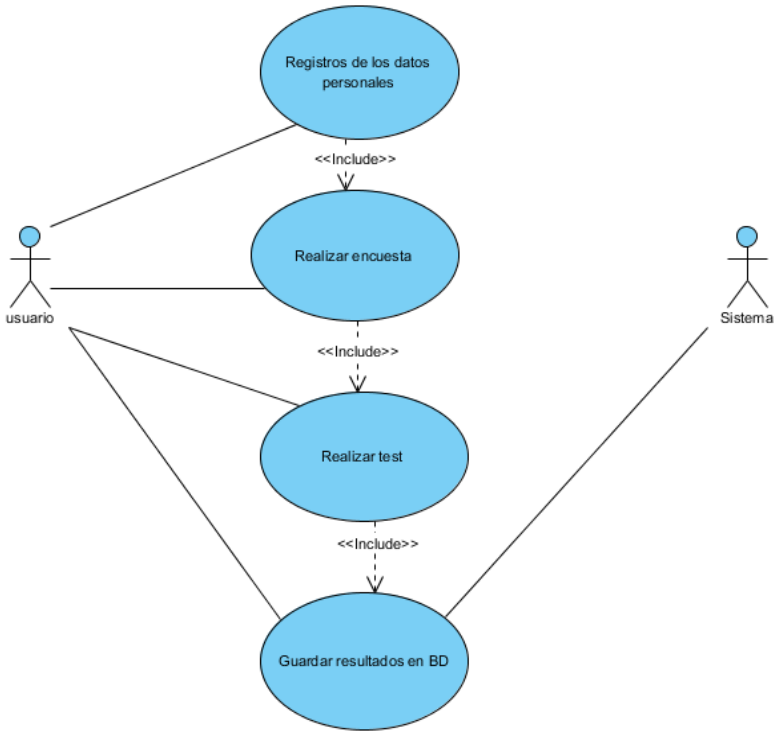
Figure 4.

Use cases.



Source: own elaboration.

IV. Results.

Procedure.

A new ADO.NET database model was created in Entity Framework, creating an organisation for each table and having access to the attributes through a controller where we made our queries.

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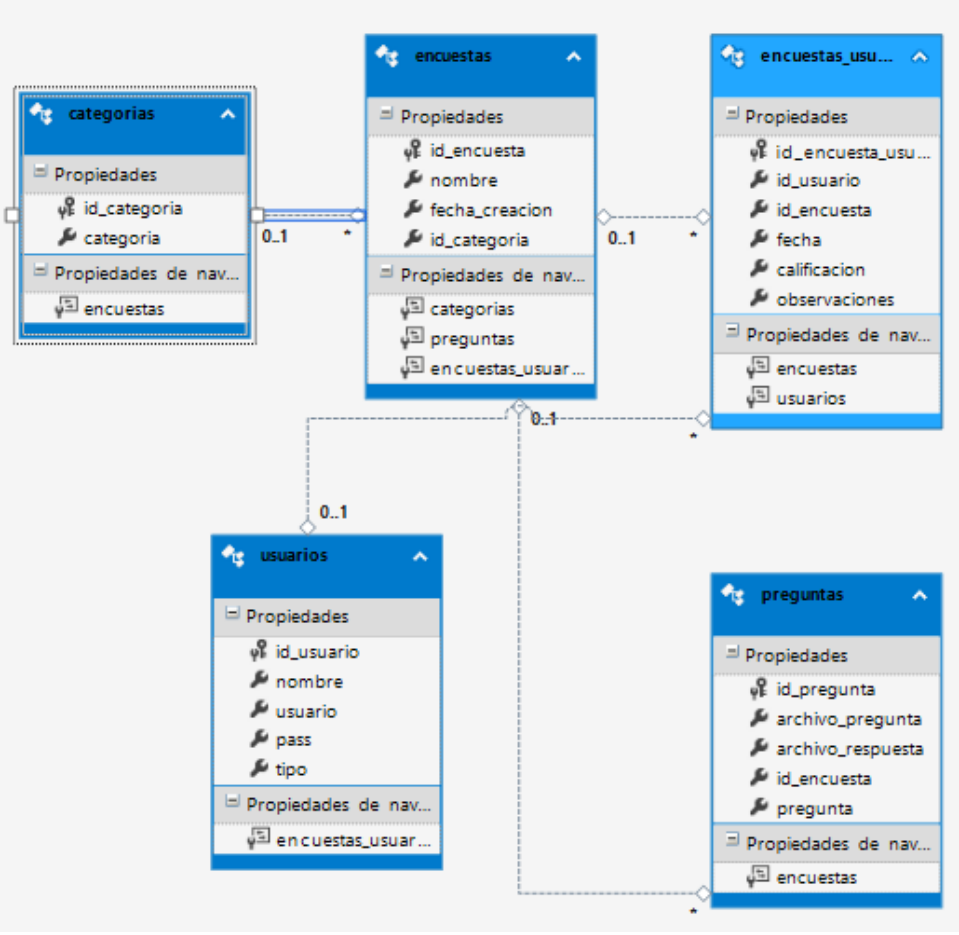
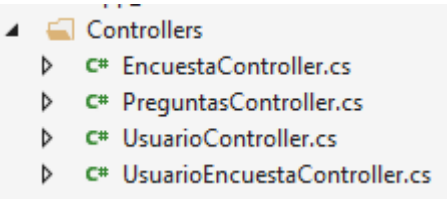
Figure 5.

Entity Framework.



Source: own elaboration.

Four controllers were added:



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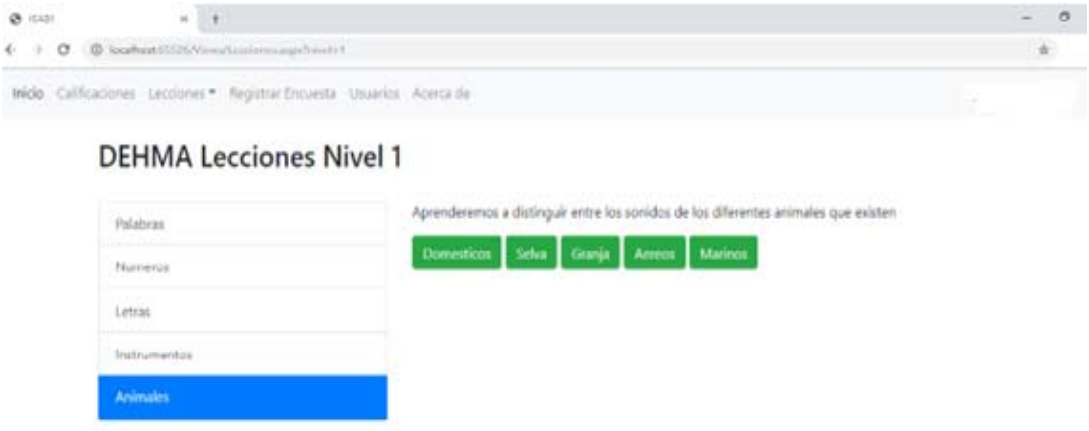
Software.

The software starts with the user authentication screen, where you can choose the type of user you want to enter the software. Supported users can be of two types: administrators (teachers) or normal (students).

In the lessons section, you can enter the category menu and select a lesson to review.

Figure 6.

Screen Lessons.



Source: own elaboration.

In the evaluation menu, you can find a menu with the different categories and the evaluations that can be performed for the categories.

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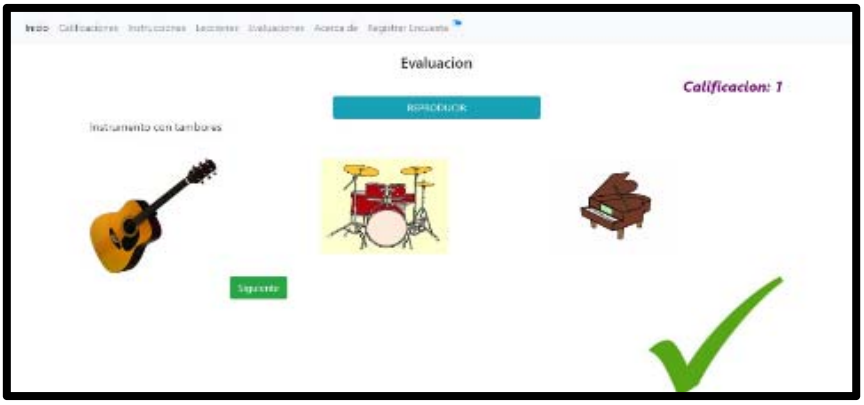
Figure 7.

Evaluation screen.

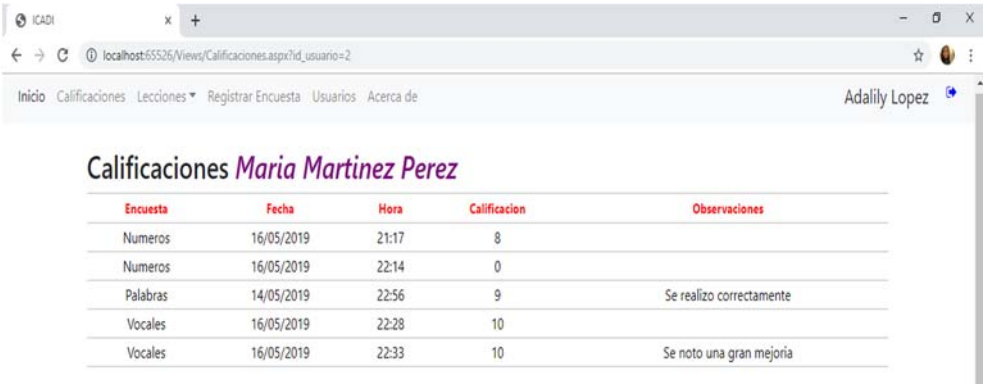


Source: own elaboration.

When accessing the evaluations made for each student we can visualise the following screen where we will find the evaluations with the date of completion and the grades obtained, in addition to a section of observations for each student. In this way, you can see a graph that shows the average grade that the student has had in each evaluation, as well as a download button, where you can obtain a PDF file where you will see this same information.

Figure 8.

Qualifications screen.



Source: own elaboration.

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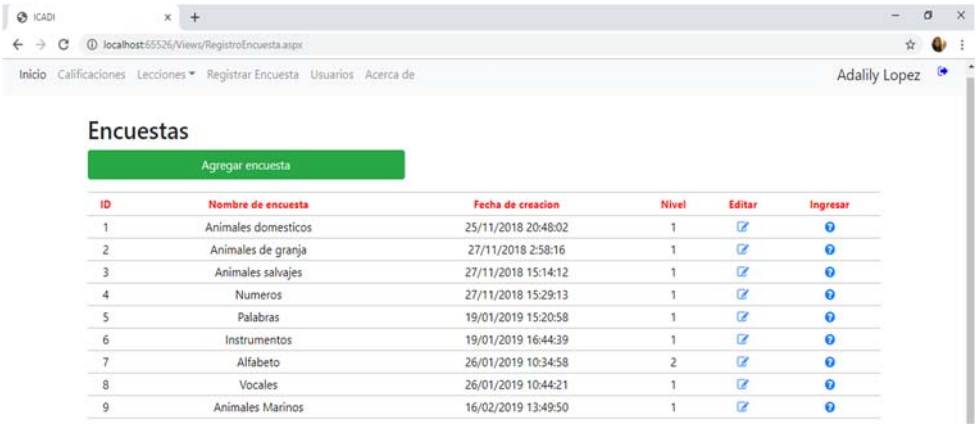
The "Register survey" shows the surveys we have registered in the system and the option to register a new one. It should be noted that the software administrator should help us with this task.

Figure 9.

Surveys screen.



Source: own elaboration.

V. Conclusions.

The development of the software took approximately 6 months because a previous prototype had been made through scheduled visits to the *Instituto de Capacidades Diferentes*. Based on this, we can determine that by considering the needs of each teacher who is in constant contact with the students, it has been extremely helpful since it is an activity that is carried out electronically, dynamically, visually and audibly.

When the software was implemented in the institution, it was very well received by students because the visual and auditory content helps to capture their attention and interest.

As for the auditory lessons, it was observed how the students were improving in each evaluation, having better auditory discrimination and, therefore, developing their hearing. For this purpose, there are records of each evaluation made by the students that show a graph of the progress made. Based on these tests, it has been determined that approximately 83% of the students have improved significantly through the eight categories that are handled and the two levels for beginners and more advanced students.

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VI. Recommendations

The software can be improved in several aspects. Among the main recommendations, the following could be mentioned:

(a) Seek help from a graphic designer for the design of the images and visual areas of the system, looking for a specific pattern to capture the attention of the students.
(b) Keep a register of the teachers who work in the institute and relate each teacher to the students they teach in each school year.
(c) Distinguish evaluations based on those performed in each school cycle.
(d) Develop the system on a mobile platform to facilitate home study.
(e) Develop an application that allows to make calls directly from the server to share resources from any platform.

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CHAPTER 12. DEVELOPMENT OF RESEARCH COMPETENCIES: AN ICT-MEDIATED TEACHER EDUCATION EXPERIENCE

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I. Introduction

In the current post-pandemic context, it is paramount to rethink the changes that this situation has generated in the training process of Higher Education students. The virtual development of classrooms and the use of Information and Communication Technologies (ICT) as a resource for the development of these, highlighted the relevance of the acquisition of digital competences by future professionals and the importance of technology as a tool that favours the achievement of learning. In the case of Pre-service Teacher Education (PTE), the use of these resources is even more significant as they are responsible not only for obtaining their own knowledge, but also for delivering it in their pedagogical practices.

It is in actual practice where the implementation and application of the competencies addressed in the training path come into play. In addition, it is crucial that institutions train and provide elements to permanently improve teaching practice. Improvement depends on multiple factors and one of them is, undoubtedly, the critical, analytical and reflective capacity of the

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pedagogical task. To this end, the development of research competencies is crucial, since a teacher who researches their practice has the possibility of evaluating their performance and, if necessary, reorienting their work in favour of student learning. Therefore, research is a transversal axis in the formative trajectory of future teachers and for the development of the competencies involved, ICT are fundamental tools at the service of their development since they optimise the research process, make it more efficient and facilitate collaborative work.

Based on the above, this chapter deals with the development of research competences in Pre-service Teacher Education mediated by Information and Communication Technologies (ICT). To begin with, a theoretical review is presented, based on three topics: ICT, research competences and Pre-service Teacher Education. This is followed by a research experience that uses technology as a resource for the acquisition of these competences in future teachers. This was developed with student teachers in a Higher Education institution in the Dominican Republic. Finally, the results that point to the products obtained by the trainee teachers are presented.

II. A theoretical approach

Global society is immersed in the information and knowledge era, which are aspects that permeate various contexts such as social, labour, cultural, economic and educational. In terms of work environment, performance in organisations is linked to competencies related to the mastery of knowledge, the analysis and processing of large amounts of data and the acquisition of high-level skills. In this new scenario, higher education has been forced to reorganise its role in favour of innovation to impact society through scientific and technological knowledge. Therefore, it must provide spaces for the development of research work since it is necessary to respond to the demands of the context and promote scientific research. The importance of the latter allows a better understanding of social reality and enhances reflective capacity (Álvarez et al., 2021). According to Ponce et al., (2021), scientific research in education is characterised by being systematic, ordered, methodical, rational, critical and reflective. Hence, to favour the fulfilment of these characteristics, the assistance of ICT is crucial.

In the current context, the explosion of information and the use of technologies highlight the development of humanity since unpredictable advances in all fields of knowledge have been achieved through them, which have had a substantial impact on the social sphere. In this context, the concept of the information society arises, which refers to the transition from

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industrial to post-industrial societies. From this perspective, knowledge is the essential factor of progress, and, from it, a structural platform is installed with organisations based on learning where the most valuable capital is the human one (Goñi-Camejo, 2000). Therefore, Higher Education must go beyond a simple transmission of information or disciplinary contents and should favour a critical and analytical vision of knowledge. In addition, it is paramount to provide research skills for the proper understanding of theories and work methodologies, as well as to promote the design of activities for ICT-mediated training. Thereby, the attitudes and skills in which students are being trained are strengthened (Norman, 2017; Montero, 2011).

Regarding the latter, the UNESCO (United Nations Educational, Scientific and Cultural Organization) ICT Competency Framework for Teachers, published in January 2008, sets out the ICT Competency Standards for Teachers and establishes guidelines on the use of ICT for educational improvement. The framework also assumes a working knowledge of the benefits of technologies and advocates their contextualization and adaptation for teachers' professional development. It is proposed that teachers should acquire competencies related to ICTs and their application with students. In this way, students become collaborative, creative, problem solvers, innovators and committed to society.

Also, this paper considers the 2030 Agenda for Sustainable Development with a view to preserving and framing digital competencies in the context of current technological advances and the changing demands of life and work. In turn, it integrates open educational resources (OER) and inclusive education in line with the fundamental principle of the Sustainable Development Goals (SDGs): "leave no one behind" (UNESCO, 2014). This agenda aims at building inclusive knowledge societies based on human rights, empowerment and the achievement of gender equality. ICTs are crucial in the progress towards achieving the SDGs (Diez de Tancredi, 2014), such as quality education (Goal 4), gender equality (Goal 5), infrastructure (Goal 9), reducing inequalities within and between countries (Goal 10), peace, justice and strong institutions (Goal 16) and partnerships to achieve the goals (Goal 17).

Although ICTs are particularly useful tools in education and research, the pandemic has generated a significant dependence on their use. Previously, they were a support resource for teaching, but today they have become an essential medium (Colás, 2021). One of the new challenges of ICT is to develop the digital competencies of teachers to perform adequately and in accordance with the scenario brought about by COVID-19. Regarding

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students' technological skills, Martzoukou et al. (2020) state that it is necessary to address students' digital competencies according to two visions: (1) as learning objectives through the educational system and (2) as a learning resource.

Another challenge is to study the relationship between ICTs and the emotional world and the consequences this has on the well-being of students and teachers (Collazos et al., 2021; Wortha et al., 2019). Currently, the transformation of education implies a modification in teacher-research training as it should emphasise the training of professionals who contribute to the transformation of the educational reality in which they work. Teachers, due to the nature of their work, must be good researchers whose purpose is to investigate their practices for continuous improvement. Pre-service Teacher Education (PTE) must prepare teachers for research and make this task a reality in a teaching-learning process oriented towards the acquisition of scientific-pedagogical knowledge, scientific-research skills and ethical values inherent to the praxis of research in education. According to Montalvo et al., (2022), if teachers have an adequate level of digital competencies and a high degree of research skills, their students will have better teaching-learning levels and excellent academic results.

In the context of COVID-19 pandemic, ICTs favoured the implementation of various educational processes and had an impact on the psychosocial aspects of human beings since, due to isolation, these tools became basic and necessary resources for student interaction. Through these tools, equal opportunities and the development of didactic strategies were favoured, becoming an important means of learning and communication that revolutionised the way of relating at a social level (Demir et al., 2022). Among their many contributions, they facilitated collaborative work, a group strategy that enhances the humanization of learning, and fostered emotions, feelings and affectivity, aspects that contribute to Emotional Intelligence (EI). Regarding the latter, García and Marín (2021) state that EI has four phases: (1) emotional perception of oneself and others, (2) emotions as mediators of thought, (3) understanding of the emotions expressed and (4) emotional self-regulation. Therefore, an educational process oriented towards the bonding of students through collaborative strategies helps the development of these phases.

Teamwork is a key element to address interpersonal skills as not only each student is responsible for the evolution of their learning, but they also commit and take responsibility for the learning and evolution of the rest of the group. However, sometimes conflicts that must be solved among all members may

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arise (Cotán et al., 2021). This requires a positive negotiation for those involved that makes visible the attitudes of the students, which may be determined by affective, cognitive and behavioural conditioning factors (Tapia, 2018). These involve the way in which discrepancies are resolved, organised, and give value to aspects of the social environment. In turn, collaborative work allows the promotion of research skills in university students (Garcés et al., 2021), both teaching and other careers, and ICT is a crucial resource for connectivity in the implementation of group work and in the linkage that is generated among participants. They also have an impact on learning, motivation, evaluation in education and research (Elvira & Gil, 2022).

III. Experience on the development of research competencies mediated by ICT in Pre-service Teacher Education

The experience belongs to the constructivist paradigm since knowledge of the real world is constructed based on processes of interactionism (Berger and Luckman, 2003). Reality and knowledge are socially configured by the participants in the research process and the results cannot be generalised out of context (Hernández et al., 2010) since different interpretations of what surrounds individuals are elaborated (Flores, 2004). Consequently, a research experience developed by students of Initial Teacher Training is presented. Then, their points of view about it are exposed. This work is situated in the qualitative approach and the method corresponds to action research. The type of work is under the qualitative approach and the method corresponds to action research. This was developed within the framework of the Phonetics and Phonology course, during the last quarter of the year 2021, with a group of 15 students of the sixth year of the Bachelor's Degree in Language and Literature oriented to secondary education of the Higher Institute of Teacher Training Salomé Ureña (ISFODOSU), Emilio Prud "Homme Campus. It is a compulsory, face to face and a theoretical-practical nature subject in specialised training. It introduces the student to the sonorous study of the native language, both in its theoretical and practical dimensions. Due to the Covid-19 pandemic, it was necessary to adapt the course virtually, a change that led to a methodological modification and the process of adaptation by the teacher who taught it.

The aim of the course is focused on the study of the sounds of the Spanish language, its acoustic constitution, graphic representation and the perception of sounds in standard Spanish. Thus, students obtain a general overview of these sounds and of the different national variations, which is an indispensable requirement in the training of language teachers. Due to the

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theoretical-practical nature and the limitations resulting from the pandemic, there is a need for a readjustment so that future teachers can acquire the necessary research skills to understand the disciplines that study the sound component of the language. This could be difficult to learn if they do not work based on real experiences that allow them to connect the theoretical bases with the real world.

Based on the implications of developing all these competencies in the context of the pandemic and the digital world, a series of questions arose: How will the development of competencies in students be achieved? How will the motivation for research be favoured in the new context? How will theory and practice be connected from the digital world? In order to answer these questions, the main purpose was to design an intervention plan for the development of research competencies mediated by ICTs and the acquisition of knowledge in the linguistic area. To achieve this, the following specific objectives were established: (1) To identify the dimensions of research skills that require greater support during the intervention process, (2) To promote the development of research skills in the subject of Phonetics and Phonology through collaborative work, and (3) To generate interest and motivation towards research in the disciplinary field in teachers of Language and Literature. Once the objectives were defined, a work route was designed to develop an intervention plan. Four phases were taken into account: (1) observation for the analysis and identification of strengths and weaknesses, (2) planning of the experience, (3) action phase and (4) reflection phase, which includes the evaluation of the improvement plan. The plan is described below.

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Table 1.

Intervention plan for the development of research competencies in future.

Intervention plan				
Phases	**Interventions**	**Activities**	**Participants**	**Time**
Observation	Reflective dialogue for practice improvement.	Virtual dialogue of experiences around the challenges and opportunities in Pre-service teacher training during the pandemic from different countries and contexts. Identification of learning barriers and transfer between theory and practice.	National and international teaching community	August-Sep. 2021
Planning	Diagnostic design. Review of the subject program. Definition of project objectives and goals.	Subject program analysis. Identification of the appropriate methodological strategy. Organisation of activities, resources and practical exercises. Selection of technological tools for collaborative teamwork. Resources identification.	EPH teacher, Coordinator and students.	Sept. 2021
Action	Action plan implementation.	Online theory lessons. Independent work in teams. Small group tutorials for the construction and development of the experience.	Course teacher with the support of a foreign academic with experience in research and Pre-service Teacher training.	Oct.-Nov.2021

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Reflection	Intervention process evaluation.	Online theory lessons. Independent work in teams. Small group tutorials for the construction and development of the experience.	Course teacher with the support of a foreign academic with experience in research and Pre-service Teacher training	Oct.-Nov.2021

Source: own elaboration.

The observation of similar groups taking the course during the pandemic showed a low motivation for the subject and a decrease in performance, since there was a lack of connection between theory and practice. This situation led to rethink the practice and decide to make adjustments to ensure the development of the course competencies. Similarly, it has been observed that in that specific Bachelor's degree, students reach the last year with low levels of research skills and little mastery of the use of ICTs, both in research methodology and in the final degree project. Therefore, the context of the pandemic was an ideal moment to apply substantial modifications in the execution of the course and, in this way, address the need to develop research competencies in students' semesters before the end of the Bachelor's degree. In this way, research knowledge and technological tools are provided for the execution of this task.

Likewise, when the achievements are oriented to the fulfilment of the graduate profile expected by the country at the time of completing the training plan, it is expected that from the disciplinary training, future teachers can use the theory to observe, understand and analyse the language from the use, the communicative situation and the social and cultural context. Faced with this important challenge, a decision was taken to make an innovation on how to approach this knowledge about language articulated with the acquisition of research skills since they are a relevant axis in the formative trajectory of student teachers.

Through reflection and dialogue with the students who took the course during the pandemic, the idea of using the project-based learning strategy was born. The purpose was to promote the development of research skills using ICTs.

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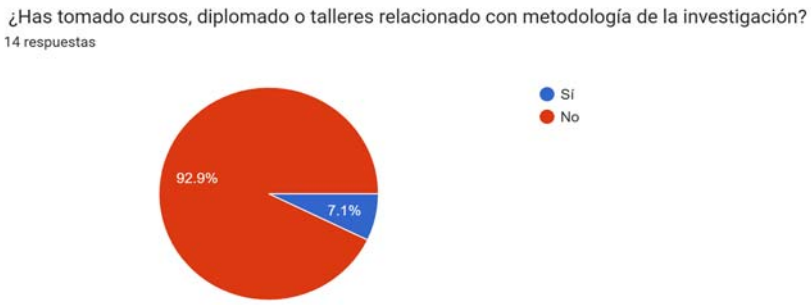
The process began with the elaboration of a self-diagnosis on research competencies in future teachers of Language and Literature oriented to Secondary Education. The survey administration software Google Forms was used in the elaboration of the self-diagnosis. The survey consisted of two parts, the first one asked about the participants' personal data and the second one corresponded to a Likert scale that evaluates the dimensions of management and selection of relevant information, technological mastery, research methodology, academic writing and teamwork.

The main results of the self-diagnosis are presented graphically below to illustrate the needs regarding research and the use of ICT for the later approach of research competencies with FID students.

Figure 1.

Participants' previous experience with research methodology.



Source: own elaboration.

This figure shows that most of the participants (92.9%) had no experience in research methodologies and only 7% had experience in this field. In addition, they do not find any relationship with the background courses that serve to strengthen their research competencies.

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Figure 2.

Level of ICT proficiency of the teachers in training.

Source: own elaboration.

As can be seen in Figure 2, the participants declare themselves competent in the use of Microsoft Word, Power point, Prezi and Canva. They state that they are incompetent in the use of bibliographic managers such as Zotero, Mendeley, EndNote, BibMe and ProCite, something that also occurs with the use of statistical data processing software such as SPSS, Stata, R, Python and Sas. Likewise with qualitative data processing software such as ATLASti, Nvivo and MAXQDA. They also state that they are little and almost incompetent in the use of Excel. In turn, they claim to be almost proficient in the use of survey software such as Google forms, Surveymonkey and Mentimeter. Finally, they consider themselves competent in the use of similarity detectors such as Turnitin, Plagiarismdetector and Copyscape.

The results of the self-diagnosis were analysed in a dialogue with the students for subsequent practical exercises on why they consider themselves competent or incompetent in the domain of research skills. From these ideas, it was determined that they overestimate themselves in several of the indicators, probably due to their lack of previous research experience. Based on these data, the teacher of the subject discusses her concern with academics from the institution and from another country (Chile). Based on this concern, the situation is presented to the campus team and authorization is requested to make didactic adjustments, which are accepted.

As for the students, they were presented with the following learning situation: "Imagine you are going to participate in next year's student congress, and you must present the results of an investigation in your community about the speech of Language and Literature teachers. To do this, you must work in a team and use different technological tools to carry out the research.

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Therefore, you need to collect data, analyse it and present it. It is important to note the competencies, learning outcomes and evidence of unit II of the program. This challenge of implementing the learning strategy, which is based on projects focused on research and the use of ICT, implied the realisation of a planning, an intervention plan and the elaboration of a research product.

In addition, the information collected was used to carry out a two-session classroom intervention with a Chilean teacher. The contents developed included research skills, information search in databases, reference managers, citation styles and general knowledge of research methodology. Moreover, the detection of similarities and suggestions on academic writing were addressed. It was carried out through the Meet platform and the use of software, applications and digital databases that assist the research process, such as Scopus, Scielo and Dialnet, was discussed. Softwares like ATLAS ti, Nvivo, SPSS, survey applications such as Surveymonkey, Google Forms, similarity detectors such as Turnitin and Plagiarismdetector; reference managers such as Endnote, Zotero, Mendeley, APA Standard 7° citation generator and on-line spelling and grammar checkers were reviewed. Finally, interview transcription software was reviewed.

IV. Results

The results emerge from the evaluation of the impact of the improvement plan and the experience developed. For this purpose, a course satisfaction survey was carried out, which the participants completed using a Google Forms online form. The information gathered is presented below.

Figure 4.

Do you feel motivated to continue researching in your area of training?

Source: own elaboration.

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Figure 4 shows that the majority of participants responded affirmatively that the internship awakened their interest and motivation for research in their area of training. However, a minority indicated that, and no student chose the option no.

Table 2.

Do they wish to continue developing their research competencies?

Participant responses
S1: "I would like to participate in research projects, but I don't think I have the time because of the academic load and because I'm slow at doing homework."
S2 "I want to continue to have the opportunity to gain experience by doing research."
S3 "I find it interesting to do research because this way we get to know fascinating and varied topics related to our °initial training."
S5 "I would like to continue learning how to do research because it is very interesting to do research in order to learn."
P6 "I find it very interesting to study a problem related to my area of study since important solutions can be derived from it. Therefore, I think it is good to learn new things, especially when it comes to education, since it is possible to understand linguistic phenomena or problems in the educational context."
S7 "I would like to continue researching, as this will give me a broader knowledge of my area of training. In the development of this experience, I discovered how much can be learned through research."
S8 "I think it is necessary to investigate problems related to my area of training in order to be able to provide solutions in the future to problems that affect student learning."
S10 "The project-based research was satisfactory and helped me to work on areas that are important but were not of my interest at the beginning of the course. Now I have changed my point of view on those research topics and teamwork."
S13 "As a future teacher in the area of Spanish Language, I would like to continue learning about the lexical, phonetic and linguistic phenomena that characterise the speech of Dominicans. In this way, I can apply theory to gain a better understanding of Dominican culture through language and its variations."

Source: own elaboration.

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Table 2 shows that obviously the participants feel very satisfied to participate in the experience. It can also be said that they feel motivated and have the desire to continue having experiences related to research from their disciplinary training. In addition, it is clear that they value research as an opportunity to connect theory and practice.

Table 3.

About knowing what it needs to be improved or changed in order for future.

Skills associated with the leadership competence	
Participant responses	*Motivate people and foster their own initiatives/new ideas*
S8 "I believe that the first thing that should happen is that all disciplinary subjects should promote strategies that help us to develop research competencies" *S13 "Work on research skills from the first year of training because everything we have to learn about research has to happen gradually."* *S2 "I think they should give us more time for research by reducing assignments and increasing the number of projects where we apply theories and practice."* *S7 "Start from the moment we arrive at the university with the use of APA and ZOTEROs."* *S15 "I think that from the first year they should have fewer short exercises and work on the basis of projects where people learn to search for data and learn to analyse them."*	*Identify the most suitable team members to coordinate and accept responsibility*
S1 "I think they should analyse the time and the amount of homework in each subject, which in my opinion does not allow us to develop research skills because we work mechanically in many exercises" *S4 "I think that university professors should plan together different subjects and put research projects that serve for more than one subject. That way, we would have less homework and more opportunity to develop course competencies."* *S6 "I think they should continue to apply strategies like the one in this course in other subjects so that we can keep practising the use of ZOTERO and the techniques of how to write articles".* *S14 "I believe that using technology as in this course would help us to better understand its functionality and use for research. It also would help us do a better work"* *S11 "I think that if research cannot be taught in the methodology subject because there will not be enough time, it should be worked transversally and from the first year of the course"*	*Define roles and tasks in a clear and understandable way*

Source: own elaboration.

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Table 3 shows how the participants would like to organise more activities or small tasks and focus on more practical work that allows them to develop competencies instead of performing mechanical tasks that only enable them to pass the courses. The other element that can be highlighted from the participant suggestions is to review the methodologies that are being used in the training process and determine if they are focused on the development of competencies. They also point out the importance of multidisciplinary planning that favours the elaboration of projects that allow the development of research skills, as well as the use of ICT from real practices, where disciplinary knowledge can be connected with practical knowledge through tasks that favour initiation and motivation, as well as the sense of research in teaching.

In view of the above, the question is: what does this experience tell us about the current challenges in Pre-service Teacher Education? The answer is aimed at rethinking practices so that the training process does not become something mechanical, which rarely favours reflection, analysis, and the connection between theory and practice. Research must be seen as a means for digital and academic literacy. Therefore, the learning capabilities of trainee teachers should not be minimised since from the first year of their training conditions should be created for them to learn through research. Teaching how to do research in Pre-service Teacher Education guarantees the creation of the foundations required for a teacher in the 21st century, which are being able to identify barriers to student learning and create the conditions to minimise these impediments so that all students learn significantly. Finally, understanding the meaning of ICT in the development of research competencies is not a task of the teachers of the methodology course, but of all trainers.

V. Conclusions

Developing research competencies in new students implies that teacher educators must make changes on a methodological and didactic level, taking as a starting point a pedagogy oriented to promote a scientific and critical spirit in future teachers, so they are capable of observing phenomena related to their disciplinary training and those lines of research that have been hardly studied. In addition, it requires designing practical approaches that allow them to observe and analyse their natural environment where they carry out their teaching practice. Therefore, Pre-service Teacher Education should be focused on encouraging experiences based on research activities from the first year of the Pedagogy careers, since this can mark a milestone in the development of research skills and promote a critical, reflective and

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analytical look at the knowledge addressed throughout the training plan. In this way, students will be able to search for bibliographic sources, systematise information, process data and articulate these actions through the use of ICT. In the same way, it is necessary to promote attitudes oriented to the good development of the teaching praxis and the psychological well-being of teachers and students (Murano, 2019).

In this experience, it is possible to see how from the Initial Teacher Training in a subject semester before graduation, teachers' assistants, through a project-based methodology, were able to carry out an action-research and reflect about it. From the work carried out, it was possible to promote and apply research skills with the assistance of ICT, a crucial support for the achievement of the project in the context of the COVID-19 pandemic. From this point of view, the proposed objective was achieved, as an intervention plan was developed that fostered the students' research competencies using ICTs. At the same time, they acquired the disciplinary knowledge of the subject, thus complying with what was stated in the program.

Regarding the specific objectives, it was possible to identify the research competencies that require greater support during the intervention process, and it was detected the need to promote the development of research competencies in the subject through teamwork. Also, it was possible to foster interest and motivation for research in the disciplinary field in teachers of Language and Literature, within the framework of the Phonetics and Phonology course of the sixth year of the Bachelor's Degree in Language and Literature oriented to Secondary Education of the "Instituto Superior de Formación Docente Salomé Ureña (ISFODOSU), Emilio Prud Homme Campus" in the Dominican Republic.

Regarding the use of ICTs in research projects, it is worth noting that it is necessary to guide and model their use through practical exercises, since they allow students to acquire digital competencies and apply them during and after their training. The use of technology in the formative process should favour the recognition of knowledge construction, its social impact, critical inquiry, dialogue and collaboration (Rojas-Betancur, and Méndez-Villamizar, 2013). Therefore, research preparation is important to be implemented in the pedagogical practice with activities that encourage the search for information in different databases, the selection of sources through clear criteria and the use of ICT. All this through strategies and the creation of simulated research and team projects. On the other hand, teachers should provide guidelines, schemes, and examples that allow future teachers to build knowledge in a sequential way during their professional training.

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When teachers are trained as researchers, they acquire the ability to reflect, assuming a more critical attitude about what they have learned and sharing it with their colleagues in order to establish synergies between what is learned and what is researched. At the same time, they understand what is being taught and why it is being taught. Hence the importance of training research teachers. For this reason, research competencies should be dealt with transversally in the training plan as they foster the critical, analytical and reflective capacity of future professionals and allow inquiry into their own practices. In this way, crucial information is obtained for decision making, in favour of improving the educational process of their students in the school context.

Therefore, it is necessary to develop research competencies from the first semester of training so that future teachers can have the knowledge, skills and attitudes required for research from the beginning of their careers; and so that they can put these competencies into practice throughout their formative trajectory. This situation considerably improves critical thinking, analysis and reflection, which substantially favours the performance of student teachers in research methodology and graduate seminar courses. These courses are taught in the last semesters and allow student teachers to have a first contact with research. By addressing the competencies in the first years, it has a positive impact on the elaboration of the final project to obtain their academic degree.

In addition, as previously stated, ICTs are a fundamental tool that significantly supports research and optimises its management. In turn, they contribute to the educational system in general, making it more open, diversified, innovative and in line with a constantly changing context. The value of ICTs is their unlimited potential for the development of innovation capabilities in the teaching-learning process, making it more creative and flexible. Their use in the research area in Pre-service teacher Education is, undoubtedly, a contribution to move towards excellence in the education of future teachers.

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CHAPTER 13. DEVELOPING COMPUTATIONAL THINKING IN PRIMARY EDUCATION

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I. Introduction

For centuries, learning to read, write and count were the basic skills needed for integration into society and the formation of citizens. The school was clothed with a power, derived from social recognition, which was the authorised institution for the conservation and transmission of culture. However, the multiple technical transformations that were taking place over time triggered, in turn, significant changes in society and culture (Quadros-Flores, & Escola, 2007, p. 235). Indeed, we live in an era of transition whose change imposes a reflection on what we learn, how and where we learn. The Decree-Law No. 55 of 6 July establishes the curriculum for primary and secondary education and the guiding principles for the assessment of learning. It shows that students need to develop skills that enable them to question established knowledge, integrate emerging knowledge, communicate effectively and solve complex problems. It also refers to the achievement of significant learning and the development of more complex

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skills, mirrored in the Profile of School Leavers. Now in an integrated way, the mentioned Profile of the students appears in the Essential Mathematics Apprenticeships (Despacho n.º 8209/2021, of 19 of August) privileging the centrality of the student in the process and his positive predisposition for learning. In addition, it gives value to the understanding and application of mathematical knowledge, in a fluent and rigorous manner, with meaning and in interaction with other areas of knowledge or reality. It also emphasises the ability to reason mathematically and to interpret and use mathematics to solve problems, forming informed, autonomous and responsible individuals. In this sense, the essential learning, in a perspective of mathematics for all and mathematics for the 21st century, presents eight objectives that all students should achieve to meet the needs of today. It emphasises a positive predisposition to learn, understanding and use of mathematical knowledge relating to different subjects, reasoning and problem solving, developing and mobilising computational thinking, communication and representation, and also developing and establishing different connections and associations (Ministério da Educação, 2021). This fact poses an emerging challenge in the ways of teaching to learn, so this study aimed to rethink the educational practice, understanding ways of teaching to learn and to think, developing critical thinking, in the context of computational thinking, in 4th grade students. It starts from the following question: How can computational thinking contribute to enhancing mathematical problem solving and the development of critical, strategic and creative skills in other areas of knowledge?

II. Theoretical approaches

Today's society is marked by a strong and dynamic acceleration provided mainly by digital technology (Quadros-Flores, 2016). Changes have touched aspects of human life and opened up opportunities for innovations that have redefined the way we live and learn and project the future (UNESCO, 2022). In this way, developing computational thinking in students becomes increasingly important, since, among many other advantages, it allows the development of critical, cognitive and creative thinking. In this context, school is an important space for learning and for exercising citizenship, which fosters guidelines for action in order to become conscious and active future citizens, aware and concerned about society's challenges/problems, contributing to the construction of a more "peaceful, fair and sustainable world" (UNESCO, 2022, p.62). In this way, developing computational thinking in schools becomes increasingly important, since, among many other advantages, it allows the development of critical, cognitive and creative thinking. Defining precisely what computational thinking is and reaching

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agreement among all researchers and stakeholders in the area in question is still something open and under current discussion and debate. One of the first researchers to talk about the relationship between computers, mathematics and society was Seymour Papert. In all his works, it is possible to understand the importance of including computing in people's daily lives, especially during school development as a means of optimising the teaching and learning process (Oliveira, 2016; Valente, 2016). Although, Papert had previously explored the connection between computers, mathematics and society and also presented the benefit that computers and digital technologies bring to the teaching of mathematics and general education (Valente, 2016), the term "computational thinking" was spread by Jeannette M. Wing (mother of computational thinking). Developing several works on the subject in order to demonstrate that computational thinking should be seen as a means of simplifying problems and challenges, where the concepts learned from computing are a guide to solve them, the author shows that computational thinking is related to the way of "thinking"/acting of a computer (Oliveira, 2016, p.19). According to Wing (2006) this skill is based on the "power and limits of computational processes, whether performed by a human or a machine" (p.2). More generally, it is about transforming a problem that is difficult at first sight, into an accessible problem to solve, through different steps and stages (Oliveira, 2016). For this reason, computational thinking is a fundamental skill for everyone, not just computer scientists. In addition to reading, arithmetic and even writing, computational thinking should be added to every child's analytical and critical skills (Wing, 2016).

Effectively, computational thinking is related to specific computer science concepts that, if taught effectively and in a connected way, can be transformed into skills and competences that can be applied both in "everyday activities and in other areas of knowledge" (Araújo, 2015, p.1). It is thus reinforced that computational thinking allows a complex and difficult problem to be transformed into a simpler challenge. For this, and according to the Essential Learning of Mathematics (2021) and Espadeiro (2021), the process also integrates practices, coming from the area of computing. These allow for the optimisation and organisation of thinking in order to facilitate the resolution of that same problem.

Computational thinking proposes more creative ways of thinking that develop in four major groups: abstraction consists in the identification and extraction of the essential information of the problem in order to reduce the difficulty of interpretation; decomposition seeks the structuring of the problem in stages of lesser complexity, being that it divides the object of study, facilitating its

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management and reducing the difficulty of the problem; pattern recognition allows for the identification of patterns and recognition of regularities and relationships in the course of the problem-solving process and consequently the application of those that prove to be most effective in future problems; algorithmics promotes the development of a sequence of steps, called an algorithm, to solve a problem so that it can be used/implemented in technological resources, promoting creativity and diversification in the resolution and representation of different challenges; debugging which seeks to test, correct errors, reformulate and optimise a given resolution presented.

Exploring and developing computational thinking brings numerous benefits to the society we live in. Thus, learning it in a school context will allow students to develop aspects essential to their social activity, such as analysing, conceptualising, exploring and solving complex selection challenges, as well as developing their critical and creative thinking. Thus, it meets one of the main essences of computational thinking, which aims to demonstrate to students an effective way to solve a problem and to "transform their ideas into models that can be used as a basis by others, making use of the skills acquired" (Oliveira, 2016, p.24).

One of the ways of developing and exploring computational thinking relates directly to the use of programming language. However, as previously mentioned, this is not exclusively related to the actual programming of a computer. Programming should be seen as a means of facilitating meaningful problem solving. When programming, students are faced with checking the effectiveness of their programs and other possible solutions to the same problem. Thus, it should be noted that programming, in addition to exploring and developing computational thinking, allows for the development of skills related to creativity, as well as skills to evaluate and control their own cognitive processes (Direção Geral da Educação, 2016).

III. Practical experience

Integrated into initial teacher training, the practice under study follows on from an activity relating to itineraries and directions. It started with the launch of a challenge through the voice of an Avatar who assumed the character of a tour guide. This character guided the learning process in a previously prepared dialogue. After recalling the previous knowledge necessary for the construction of new knowledge such as "full turn", "half turn", "quarter turn", "right turn", "left turn" and the coordinates in grids, the class was challenged to guide a group of tourists recently arrived in the city. It should be noted that the city of Matosinhos is bathed by the Atlantic Ocean and often receives

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cruise ships with hundreds of tourists. Stimulating entrepreneurship is today also a necessity in the training of citizens who live in a changing world. Entrepreneurship requires critical and creative skills, skills developed in computational thinking. The educational practice when integrated in a family environment becomes meaningful and emotional, essential elements to the learning process. The activities, when contextualised, enable involvement and interest, essential to the development of significant learning. Thus, in the present study, we started from the students' everyday life and from one of the main economic activities of their city, tourism. Following this starting point, the challenge launched to the class consisted in finding and describing itineraries to show the city of Matosinhos to tourists, who would have to pass through strategic places for shopping, visit the main historical points of the city and, also, attend cultural moments. The route started at the school the students attended and passed through the museum (MUMMA), and other sales areas, including sardine cans. Using a grid map adapted from the city map (they made it themselves) (Figure 1), the students, organised in pairs, had to mobilise knowledge about orientation and location in space, using coordinates, and to trace routes using arrows or coordinates. Regarding the routes, they were to trace all the possible paths, following the instructions provided, so that in the end they could give an answer to the question initially asked.

Figure 1.

Square grid, adapted from the Matosinhos city map. Own source.

Source: own elaboration.

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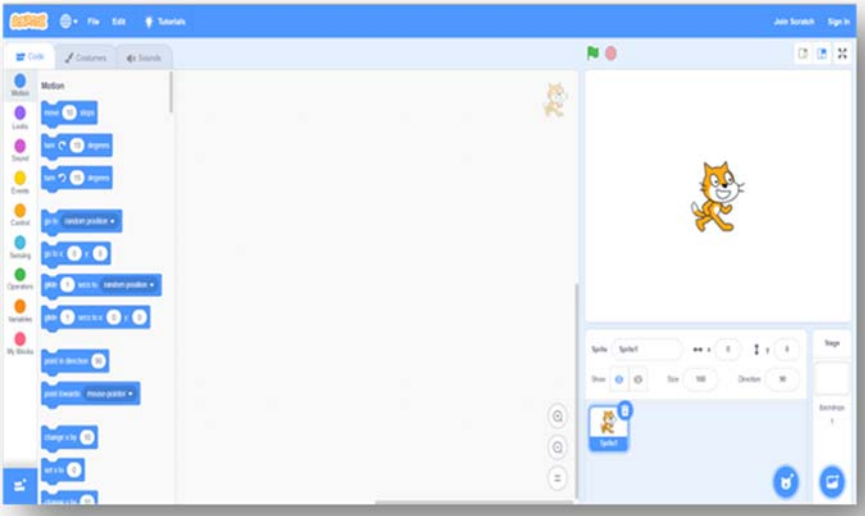
After recognizing and representing all these paths and identifying the shortest path, they went to check and visualise the route through the online and interactive application Scratch (Figure 2), which is characterised as a type of visual programming based on blocks, which allows creating stories, games and visual animations. It was proposed to each group, to create an animation that represented the route that tourists had to take. Later, in a second moment, they were asked to discover the inverse path, that is, the way back to school, guided by new directions. The discovery and identification of patterns, by involving the recognition of relationships and regularities (Espadeiro, 2021), allows the facilitation of the resolution of other similar problems, through the application of previously identified and tested resolution strategies. The importance of integrating in the learning process a moment of application of the knowledge constructed should be emphasised. The mobilisation of this knowledge in the construction of new knowledge raises thinking to more complex spaces.

Figure 2.

Scratch application. From Scratch - Imagine, Program, Share (mit.edu).



Source: own elaboration.

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The third and last moment of the pedagogical activity was intended to create, in a large group, a storytelling that narrated the story of the tourists and their journey to the Museum. According to Fernandes (2017), mathematical communication must be developed in a convenient way, from oral to written, respecting the different phases of knowledge appropriation. Thus, this moment of systematisation occurred at a later moment after the acquisition of the new concepts. It should be noted that this moment is particularly important because it implies a critical reflection on the process and the knowledge built and its mobilisation in a new context, which also involves mathematical communication in an environment in which communication in the native language is also essential.

IV. Results

The aim was to understand how computational thinking can contribute to the development of mathematical problem solving and the development of critical, strategic and creative skills in other areas of knowledge. Thus, along with observation, field notes and the students' productions were essential, in order to understand the reasoning and mathematical communication that were being established throughout the development of the different moments of the activity. Currently, and as recommended in the DL no. 55/2018, of 06 July, the curriculum is developed in order to give main importance, not only to the cognitive development and the contents of disciplinary knowledge, i.e. knowledge and know-how, but also to the social and emotional development, at the level of knowing-well being and knowing-being, fostering in students "skills that allow them to question the established knowledge, integrate emerging knowledge, communicate efficiently and solve complex problems" (p. 2928). In this sense, in a transdisciplinary way, skills at the level of cognitive knowledge and social and emotional skills were explored, promoting entrepreneurial and creative skills and integrating cultural and situated knowledge. It should be noted that we have integrated a subject of daily life, familiar in the Municipality of Matosinhos. Recognising knowledge that is useful in life is difficult to forget, so it stays with individuals for longer. On the other hand, familiar knowledge takes on a unique meaning that facilitates memorisation and introduces meaning to the learning process. Understanding in the process promotes learning, as the child is able to relate new knowledge to prior knowledge (Ausubel, 1968). By way of simulation, the activity started with the reading aloud by one of the students of the class, of the email sent by the fictitious Department of Culture of the city of Matosinhos. It was observed that the reading of that same email captured the attention of all the elements of the class, since an important institution addressed them to a communication. In this message, the fictional character,

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Gustavo, challenged the class to help guide a group of tourists who arrived on a cruise ship at Porto de Leixões (Matosinhos) to the Casa da Memória de Matosinhos (MUMMA Museum), leaving from the school where they were staying. For that purpose, attached to the email was a grid, adapted from the city map, with the name of the streets where the tourists would have to pass and the main conditions imposed, namely: discover all the paths that can be travelled, knowing that it is not possible to go down, nor turn right and it has to pass Goa Street so that the tourists can observe the commerce of that street. The students, in groups, were expected to take on the role of tour guides, so they would first have to get to know their city. From an entrepreneurial perspective, the itinerary includes some key shops, so that tourists can do some shopping, and the Museum to get to know the local culture. Once the challenge was understood, the following guiding questions were asked: "How can I help Gustavo to guide tourists, according to the conditions imposed in the email?"; "So, what are the possible ways to get to the Museum passing by some shops/markets selling sardines? All these questions refer to the development of their thinking and the structuring of their reasoning, following the different phases characteristic of computational thinking (Ministério da Educação, 2021). In order for everyone to understand the projected mesh, a small exploration and discussion of the mesh was initially performed in a large group. This initial exploration met the moment of abstraction, corresponding to the first phase of computational thinking: "How can we simplify this problem/task? How can we solve the problem?" (Espadeiro, 2021). This created an opportunity for the students to represent the problem in a simplified way, focusing on the most relevant information. It was visualised and found that, from that moment on, the students concentrated their attention on the route they had to follow and the streets where tourists had to pass and did not get distracted by the other locations. After the exploration, one of the students went to the board and following the indication described in the email and recalling some of the concepts explored in previous years about location and orientation in space, traced one of the possible paths and explained it by mobilising the coordinates of the starting point and the arrival point (Figure 3).

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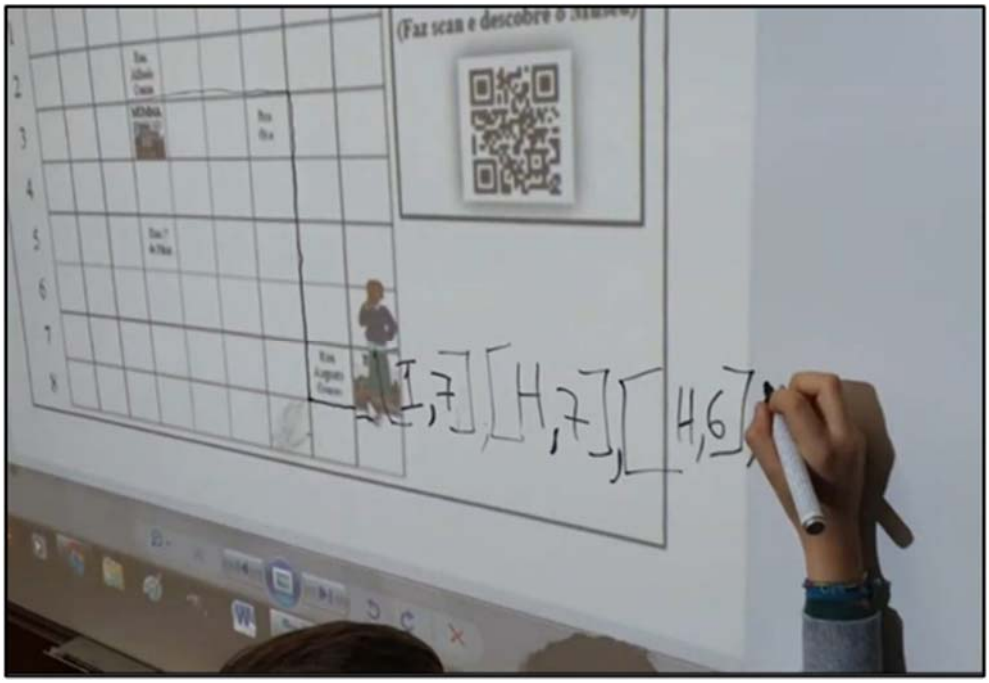
Figure 3.

Identification and representation, through coordinates, of the possible path.



Source: own elaboration.

Transcribing the words of student (F) "So, the first point, that is, the starting point, is (I,7) (the student while thinking out loud, goes writing the coordinates on the board), then it goes forward to (H,7), then it goes up to (H, 6) next we go up to (H,5), next we go to (H,4), then we go to (H,3), which curiously is the name of a restaurant, then we turn left to (G,3), then we continue to (F,3), (E,3) and we reach the Museum which is at (D,3). " This moment shows that the student was able to identify the connection between points and meet the initial rules of the challenge. He found several routes and knew how to choose the shortest and only correct one. It was observed that all groups chose to identify the different routes with different colours. This made it easier to identify features and details that revealed similarities and differences. So, visual image of the distance of the routes facilitated problem solving, in this case the shortest route by which they should follow the tourists. It was verified, thus, that through the decomposition, the learner structured the resolution of the problem, by steps of less complexity, so that it was easier

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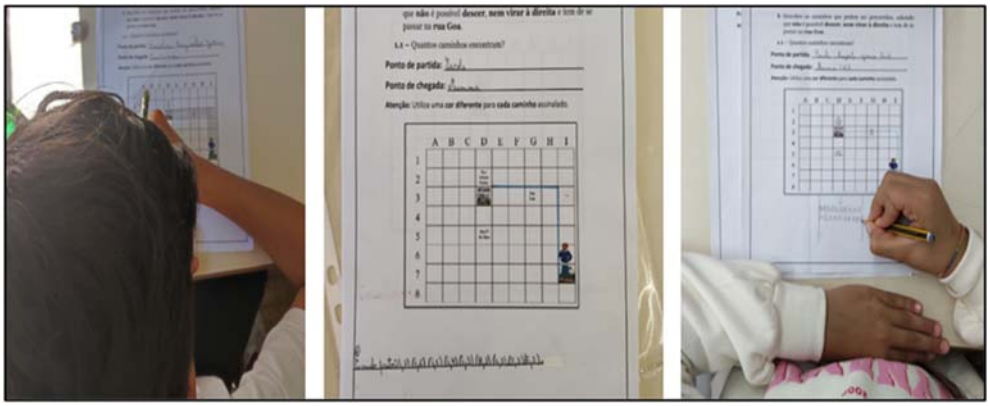
to solve it. In this process, the learner also recognised regularity and relationships. This competence allows the discovery of solutions to common problems, developing the enterprising spirit in students. So that all their reasoning and mathematical representations could be recorded and later presented orally or in writing, each student was provided with a sheet of paper that presented the design of the mesh, the indications to be respected (Figure 4).

Figure 4.

Representation, by each group, of the possible path.



Source: own elaboration.

After several discussions and sharing of ideas between the different elements of each group and between the different groups, and after several attempts at error, the class concluded that there was only one possible path, respecting all the points of the directions. It should be noted that during the time it took to solve the challenge, several students stood up and moved around the room, playing the role of the character represented on the grid and making the different paths and "necessary quarter turns". This whole process leading up to the final conclusion was particularly important, because through different ways of thinking and reasoning the children were sharing their ideas and working together. It should also be noted that, from the beginning of the activity, the enthusiasm was evident, with the student [F] stating the following "Learning this way is easier! I hadn't understood the quarter turn with the other teacher and now I have! In order to make possible the animated visualisation of the path found and realising that this was the only one possible, we used the visual programming language Scratch, which allows us to create games in a fast and simple way. Integrated in the last

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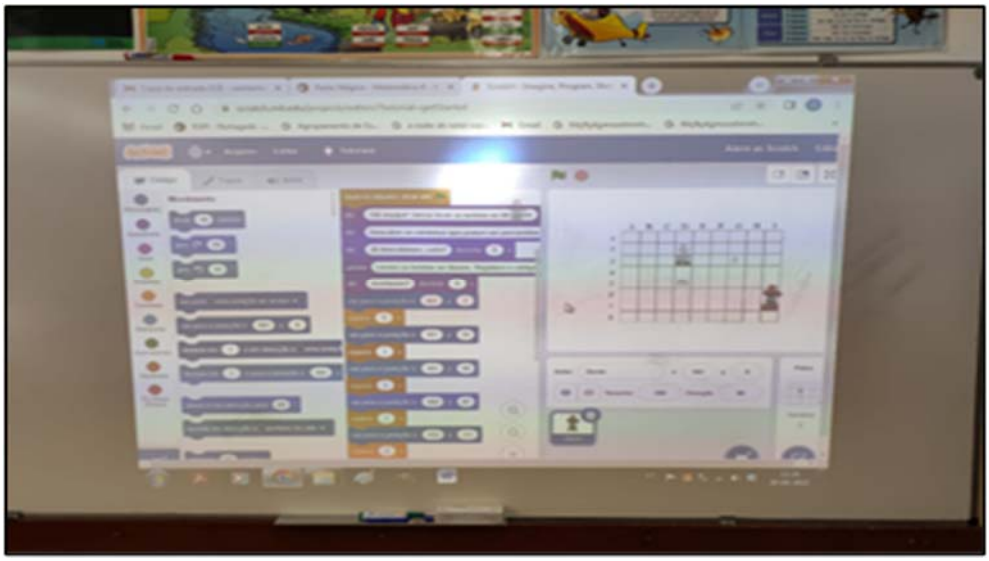
phase of computational thinking, debugging stimulates the ability to identify errors by testing, refining and optimising the resolution (Ministério da Educação, 2021). The Scratch application was explained in a large group, but used by children in small groups, or even individually (Figure 5).

Figure 5.

Programming, in Scratch application, the path found.



Source: own elaboration.

In a second moment of the activity, in order to put the knowledge built into practice, each group was challenged to indicate the opposite path to the one previously discovered, i.e. all the possible paths from the Museum to the school, following new orientation indications, so that tourists could move through other streets in order to get to know new places. This task provides an insight into whether students have introduced meaning to the process and recognise patterns, and whether they have integrated the new knowledge by making connections. Knowledge is built when there is meaning for the child who learns. So that all the dynamics of the previous moment could be the same, each element of each group was once again given a sheet of paper with the same drawing of the mesh, with the small difference of the initial position of the character and the indications to be respected. Without any indication, or help having been given, it was possible to verify that, quickly, the students found that they would have to use the same patterns of the

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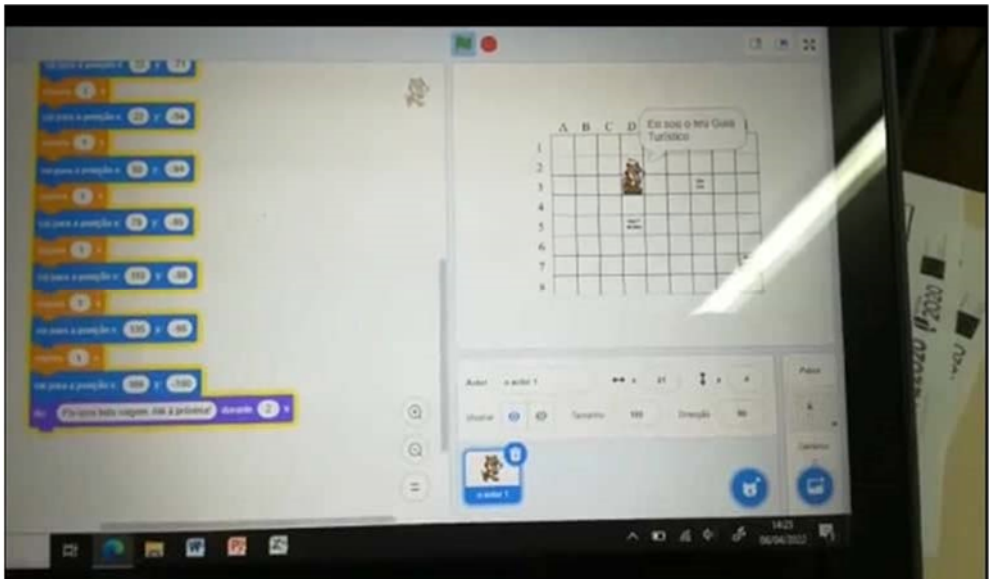
resolution of the previous challenge in solving the new problem. This realisation, coming from the development of computational thinking, allowed them to structure their thinking, which facilitated and accelerated the resolution of the new challenge. All these conclusions emerged from the promotion of several moments of sharing the different reasoning and ways of thinking of each child, which also led them to verify that, in this same challenge, as in the previous one, there was also only one possible path. After one of the students voluntarily went to the board and explained to the class why there was only one path, which fulfilled all the given indications, and wrote down its coordinates, each group autonomously programmed and gave the necessary indications to the program to generate the code which made the character follow the path found (Figure 6).

Figure 6.

Example of the programming, in the Scratch application, of the path found, by one of the groups.



Source: own elaboration.

Through the articulation between the Cultural Heritage (customs, traditions, symbols, holidays) and the itineraries (Environmental Study), it was possible to develop and explore the children's computational thinking, explore different reasoning and mathematical representations, establishing

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connections and associations with reality and also promote spatial orientation, describing positions, using the identification of coordinates (Mathematics) (Ministério da Educação, 2021). It was also possible, through various moments of sharing and discussion of opinions and ideas, to promote communication skills and collaborative work. This articulation also made possible the participation of all the students, even those who presented more difficulties, not only at a cognitive level, but also at a socio-emotional level. The inclusion of all of them in various moments of debate and sharing of ideas was thus observed. In order to make known and share all the work developed and valuing the initiatives and ideas of the class, still during the dynamization of this activity, it was proposed, in a final moment, the creation of a Storytelling that narrated the story of the tourists and the path taken by them to the Museum. The use of this resource was chosen as it allows the mobilisation of knowledge, valuing intertextuality, mathematical communication and transversal reasoning. Furthermore, in the context of mathematical and digital literacy, various resources were integrated to encourage communication and sharing. The articulation of theory and practice, how to apply and apply by critically reflecting and acting creatively gives students the opportunity to learn to think, checking and reflecting on the solution. Collaborative argumentation in the group allowed negotiation of meanings and the development of critical and creative thinking through dialogue. Reflecting effectively improves personal skills as it involves intellectual capacity and skills of thinking, collaboration and evaluation. The reflection at the end of the activity and the comments made by some elements of the class throughout its development clearly showed that the students enjoyed the pedagogical moment developed, as well as the way they put their knowledge into practice. Some students even said that mathematics seemed easier, that they were able to solve the problems and even one of the students with more difficulties said that she was able to understand everything and do all the exercises without difficulty.

V. Conclusions

In view of the changes, it is necessary to rethink the school to provide opportunities for students to develop 21st century skills. The knowledge, skills and attitudes are foreseen in the new curriculum documents in order to train citizens who can participate actively and autonomously with responsibility, reflecting critically and creatively the consequences and contribute to the common good. Thus, it was verified that the process of thinking that involves the formulation of problems and the means to reach their solutions, fosters computational thinking. Problem-based learning challenges critical and creative thinking to find solutions. The educational

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practice integrated a context familiar to the children's everyday life, therefore making the learning process meaningful. This process involved the student with himself and with others in an enterprising and critical attitude. It promoted not only the construction of new scientific and contextual knowledge, but also skills at mathematical reasoning level and at personal level, resilience, logical reasoning, critical and creative thinking capacity. Thus, in the first moment, the students focused their attention and their thinking to the main objective of the problem, they decomposed that same problem into easier and more accessible parts, they created and identified patterns and designed the algorithm necessary to its resolution, which was verified by the use of Scratch. The structuring of thought and the development of critical and reflective thinking, promoted by problem solving, through the stages of computational thinking, allow them to understand relationships, discover patterns and connections and test solutions, which facilitate and speed up the overcoming and resolution of diversified challenges and problems, both mathematical and from other areas of knowledge. It has been found that the process responds to all students, as all children can find creative ways of thinking, interpreting and verifying. It also breaks with the fragmentation of knowledge by enhancing holistic learning. Computational thinking is a fundamental skill for all.

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"New Trends and Research on Digital Education, Technopedagogy, and Curriculum" delves into the effective integration of technology in education, emphasising the significance of technological, pedagogical, and curricular knowledge for teachers' initial and continuous training. The book explores techno-pedagogy, digital education, and curriculum as interconnected components that synergize to enhance teaching and learning processes. It addresses the adoption of innovative pedagogical strategies mediated by ICT, especially crucial during the Covid-19 pandemic, to transform and enrich educational practices, leading to a redirection of the teaching and learning process. It emphasises the need for appropriate technology use in education and highlights the importance of digital pedagogy in positively impacting learning outcomes.

The book is designed to serve as a valuable resource for educators seeking to integrate ICT effectively into their teaching and learning processes. It provides an updated and accurate guide on how to think, process, and communicate knowledge and techno-pedagogical practices. The text covers various topics, including educational robotics, collaborative methodologies, digital platforms for science learning, and the flipped classroom approach. It advocates for the redesign of curricula and policies in teacher education, empowering new teaching models and paradigms, and fostering the development of digital and research competencies in teachers and students.

Throughout the book, a critical and balanced approach is encouraged, recognizing that technology and science are powerful tools that can be used for both good and harm. The text encourages reflection and debate on the role of technology in education and the impact on children, young people, and educators in initial and continuous education. It underscores the importance of adopting technology as an instrument in service of humanity rather than a substitute for human beings. The book acknowledges the value of technological advancements in education while promoting responsible and thoughtful usage for the betterment of society.