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An Examination of Methodological Approaches in Applied Technology Classrooms: A Reflective Perspective from Vocational and Training Educators

Estudio sobre los enfoques metodológicos en las aulas de tecnología aplicada: una perspectiva reflexiva de los educadores de la Formación Profesional

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ABSTRACT

This research exposes the pertinent methodological considerations regarding digital competence for educators in Vocational Training Applied Technology classrooms. The study employs deductive thematic analysis, a well-established design recognised for effectiveness in examining and validating specific theoretical frameworks. To uphold the thematic analysis's rigour, it incorporates thorough preparation, systematic methodologies, and meticulous record-keeping, particularly when handling extensive datasets. Instruments were used for research in six vocational education and training (VET) institutions with Applied Technology Classrooms (ATCs) in Catalonia's Tarragona, Barcelona, and Lleida provinces. The study included interviews and focus groups with twenty-five participants, and two classes were observed after data collection was processed with the Turboscribe.ai application and uploaded to the ATLAS.ti system Version 24.1.1 for analysis of the participants' discourse. Participants have addressed integrating advanced technologies, including 3D printing, virtual reality, and laser cutting, into the educational framework of ATC as the pivotal seeker to transform and modernise vocational education. This strategic incorporation has the potential to revolutionise teaching methodologies, allowing students to engage in experiential learning and directly apply theoretical knowledge. However, some significant challenges have been identified: (1) the pressing need for VET teachers to improve their digital competencies. (2) Furthermore, there is a need to address the implementation of digital mentorship and training initiatives and the practical digital instructional skills of educators and their official certifications. (3) A frank methodological approach is needed to develop better actions in the ATCs.

KEYWORDS

AtecA Classrooms; Teaching Digital Competence; Deductive Thematic Analysis; Vocational Training

RESUMEN

Esta investigación intenta mostrar las consideraciones metodológicas pertinentes en torno a la competencia digital para los educadores que participan en las Aulas de Tecnologías Aplicadas en la Formación Profesional. El estudio emplea el análisis temático deductivo, un diseño bien establecido y reconocido por su eficacia en el análisis y la validación de marcos teóricos específicos. Para mantener el rigor del análisis temático, se incorpora una preparación exhaustiva, metodologías sistemáticas y un mantenimiento meticuloso de registros, especialmente cuando se manejan conjuntos de datos extensos. Se utilizaron instrumentos para la investigación en seis instituciones de formación profesional (FP) con Aulas de Tecnología Aplicada (AtecA) en las provincias catalanas de Tarragona, Barcelona y Lleida. El estudio incluyó entrevistas y grupos focales con veinticinco participantes, y se observaron dos clases después de que la recolección de datos fue procesada con la aplicación Turboscribe.ai y cargada en el sistema ATLAS.ti versión 24.1.1 para el análisis del discurso de los participantes. Los participantes han abordado que la integración de tecnologías avanzadas, como la impresión 3D, la realidad virtual y el corte láser, en el marco educativo de ATC son fundamentales para transformar y modernizar la formación profesional. Esta incorporación estratégica tiene el potencial de revolucionar las metodologías de enseñanza, permitiendo a los estudiantes participar en el aprendizaje experiencial y aplicar directamente los conocimientos teóricos. Sin embargo, se han identificado algunos retos importantes: (1) la necesidad apremiante de que los docentes de FP mejoren sus competencias digitales. (2) Además, es necesario abordar la implementación de iniciativas de tutoría y formación digital y las habilidades prácticas de instrucción digital para los educadores y sus certificaciones oficiales. (3) Es necesario un enfoque metodológico concreto para desarrollar mejores acciones desarrolladas en las aulas AtecA.

PALABRAS CLAVE

Aulas AtecA; Competencia Digital Docente; Análisis Temático Deductivo; Formación Profesional

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Main contributions of the article and future lines of research:

- The paper developed here signifies the commencement of a critical research initiative that seeks to underscore the imperative requirement for ongoing exploration of the incorporation of technology within VET educational environments.
- Research endeavours should be concentrated on discerning optimal strategies for integrating a multidisciplinary approach and establishing an academic framework for utilising ATCs.
- Prospective investigations should also explore the use of reliable qualitative and quantitative instruments to effectively measure VET teachers' Teaching Digital Competency and apply DT in the classroom.

1. INTRODUCTION

In contemporary educational contexts, the pioneering and innovative nature of Applied Technology Classrooms (ATC) represents a unique instructional design approach (San-Martín y Miranda, 2020). These classrooms are intended to equip Vocational Education and Training (VET) students with critical digital competencies, responding to the demands of an evolving digitalised and sustainable global landscape (FPinnova, 2022). ATC facilities are outfitted with state-of-the-art tools and technologies, facilitating immersive learning opportunities customised to the distinct professional domains of the students (Kumótica, 2022). The primary objective of these classrooms is to acquire a well-prepared workforce for a highly competitive and technologically progressive employment market, achieved through experiential education in cutting-edge technologies (Borden-Lanza et al., 2023).

The theoretical framework underpinning technology integration in VET underscores digital competence development. This entails the acquisition of informational, technological, multimedia, and communicative proficiencies essential for participation in the knowledge society. Digital competence denotes the effective utilisation of technological resources to address everyday challenges, a pivotal aptitude for students and educators. The Ministry of Education and Vocational Training accentuates the significance of these competencies in equipping students to meet the necessities of the contemporary labour market (España Dirección General de Formación Profesional, 2022).

Spain is actively addressing significant challenges in aligning its educational outcomes with the evolving demands of the labour market (España Consejería de Educación Cultura y Deporte, 2021). Similarly, efforts are underway to raise digital competencies, as a low percentage of the population currently possesses specialised digital competence, below the EU average (Martin, 2015; Ojeda et al., 2019; Verdú-Pina et al., 2023). VET programs are leveraged as critical tools to tackle these challenges by offering innovation and professional skills training (Del-Cerro-Velázquez & Ramón-Cano, 2018; Merino-Pareja & García-Gracia, 2022; Rego-Agraso & Rial-Sánchez, 2017). In the same way, key initiatives, such as the Strategic Plan for VET and the Modernisation Plan for VET, are being implemented with significant emphasis on driving digital and ecological transitions in the education system, focusing on equipping students with the skills necessary to thrive in a technologically advanced and sustainable economy (Ministerio de Educación y Formación Profesional, 2020).

The development of ATC classrooms forms an integral component of an expansive initiative to modernise the Spanish Vocational Education and Training (VET) system. As 2012, Europe and Spain witnessed the emergence of the Future Classroom Labs and the Makerspaces, representing a significant evolution of educational practice (INTEF, 2017). These specialised instructional spaces are meticulously crafted to mitigate the disparity between academic attainments and the difficulties of the labour market, with a specific focus on equipping students with hands-on experience in digital technologies (Cardoso et al., 2020; Moreno-Guerrero et al., 2021; Rego-Agraso et al., 2015; Ros-Garrido, 2021).

Recent research demonstrates that educators with advanced digital competence are more inclined to employ teaching methods that effectively integrate digital technologies, and This underscores the

significance of enhancing teachers' digital capabilities to improve their quality of education (Casal-Otero et al., 2021; Cervera et al., 2016; Cisneros-Barahona et al., 2023; Paz-Saavedra & Gisbert-Cervera, 2023).

Thus, it is imperative to acknowledge the significance of ATCs in VET and further investigate this phenomenon to understand its implications and impact (Sambró et al., 2023). An ample comprehension of ATCs is pivotal in identifying and addressing challenges associated with integrating digital technology within these educational environments. Furthermore, it is essential to investigate the impact of ATCs on the TDC of VET instructors (Borden-Lanza et al., 2023). The recognition of the potential of ATCs to modernise VET and equip students with needed skills for the contemporary job market can significantly shape the future landscape of education and workforce preparedness (Aulas, 2023; FPinnova, 2022; Kumótica, 2022; San-Martín & Miranda, 2020).

2. METHOD

A qualitative methodology has been employed as the guiding axis for this research, prioritising the pursuit of understanding over generalisation (Creswell, 2014; Harrison et al., 2020). By branching qualitative research to utilise a thematic analysis approach, the researchers emphasised predefined themes and systematically applied them to the collected data. This methodology allowed the researchers to focus on discourse analysis, ultimately contributing to developing and validating existing theories on using DT in the classroom (Soratto et al., 2020).

2.1. Research Objective

The preceding discussion comprehensively underpins the specific aim that underlies this research endeavour. The objective can be articulated as follows:

- Identify relevant methodological aspects for Vocational Training teachers regarding digital competence in the context of ATC classrooms.

2.1.1. Research Question

This research endeavours to furnish comprehensive insights addressing the following pivotal research inquiry:

- What methodological aspects are relevant for vocational education and training (VET) teachers regarding digital competence in using ATC?

2.2. Sample and Procedure

The data collection phase lasted from May to July 2024 and encompassed a cohort of 25 participants distributed across 6 ATCs established within public Vocational Education and Training (VET) centres in Catalonia. This representation included professional families in Electronics, Electricity, Health, Construction and Works, Image and Sound, and Mechanical Manufacturing. The primary focus of this investigation was to elucidate the contextual factors surrounding these educational environments, explicitly examining the dimensions of monitoring, assessment, and working plans (see annexe 1).

2.3. Design

This study employs deductive thematic analysis, a design widely recognised for its efficacy in exploring and validating specific theoretical frameworks (Clarke & Braun, 2017; Fife & Gossner, 2024; Pearse, 2019). This method is particularly advantageous in fields with well-established theoretical frameworks, as it enables researchers to explore how these theories manifest in real-world contexts (Naeem et al., 2023; Xu y Zammit, 2020).

This study has integrated thorough preparation, systematic methodologies, and comprehensive record-keeping to maintain rigour in thematic analysis, especially when dealing with extensive datasets (Maher et al., 2018; Nowell et al., 2017). Fundamental approaches were considered imperative for enhancing rigour in thematic analysis (see annexe 2).

The outcomes, which draw on a comprehensive review of official Spanish documentation (Borden-Lanza et al., 2023) and a systematic literature review (SLR) that examined key elements in the most recent publications on vocational education, technical skills, and digital competencies, have played a crucial role in developing a robust and well-supported coding framework.

2.3.1. Instrumental outcomes in creating a solid and well-supported code framework.

Table 1.

Instrumental outcomes in creating a solid and well-supported code framework.

Research Questions	**What methodological aspects are relevant for vocational education and training (VET) teachers regarding digital competence in using ATC?**		
Categories	Codes	Sub-codes	Final version Chosen Items
Methodology in the *ATC* Classroom	Monitoring	1. Achievement of Intended Objectives	item 1: How is the digital project of the centre linked to the *ATC* Classroom monitored?
			item 2: In relation to the development of Digital Competence, what benefits does the *ATC* Classroom provide for students?
			Item 3: In relation to the Digital Centre Project, what aspects do you consider that are not covered by the *ATC* classroom?
		2. Teaching Digital Competence	item 4: How is Teaching Digital Competence related to the dynamization of the *ATC* Classroom?
			item 5. How are digital technologies promoted from the *ATC* Classroom?
			item 6: In terms of monitoring, how are the *ATC* classrooms aligned with the development of the Digital Competence of students and teachers?
	Assessment	3. Related projects	item 7: What projects have been developed from the *ATC* Classroom?
		4. Creativity, innovation, professional activity	8. How does the *ATC* Classroom help to promote creativity, innovation and professional activity of VET students?
			9. How does the *ATC* Classroom help to improve the social and personal skills of VET students?
		5. Methodological changes	item 10: Do the activities carried out in the *ATC* Classroom imply a change in methodological approach that allows

			promoting student motivation, as they are the main axis of the teaching and learning process?
	Working Plan	6. Work Environment	item 11: How does the methodological approach of the *ATC* Classroom help to meet the needs and expectations of the labour market?

Table 1 describes the deductive thematic analysis protocol that was applied. The Methodology in the ATC Classroom category regarding the specific research questions were identified and coded. Additionally, three codes were delineated through the Systematic Literature Review (SLR) and Documentary analysis, identifying six subcodes and eleven items. The comprehensive and systematic Deductive Thematic coding approach entailed the meticulous design and development of three specialised instruments for data collection. The analysis of the coding-identified themes and the research items for the data collection instruments was performed using ATLAS.ti system Version 24.1.1 (30840).

These instruments included an interview aimed at VET administrative ICT or Digital Mentors (see Annexe 3), a focus group for VET teachers utilising ATCs (see Annexe 4), and an observation guide for application during the development of a class in the Applied Technology classroom (see Annexe 5). Rigorous validation of these instruments was conducted through a double itinerary process, which involved expert validation utilising the Delphi method.

3. RESULTS

The instruments were applied in six vocational education and training (VET) institutions where Applied Technology Classrooms (ATCs) are already in place. These institutions are situated within three provinces of Catalonia: Tarragona, Barcelona, and Lleida. Interviews and focus groups involved the participation of twenty-five individuals, and two classes were subjected to observation. After the instruments were applied, the data underwent processing through the Turboscribe.ai application. Following thorough retrieval, analysis, revision, and cross-referencing of the data to ensure full compliance with the original recordings, those resultant documents were uploaded to the ATLAS.ti system Version 24.1.1 to examine the participants' discourse. Table 2 shows the Coding and Characteristics of Reached VET institutions for data analysis and interpretation.

Table 2.

Coding and Characteristics of Reached VET Institutions for data analysis and interpretation.

Code	Participants	Province	Professional Family attached to the ATC classroom	Data collection instrument applied
IBF	1	Barcelona	Electronic Electricity	Interview
IC	1	Tarragona	Health	Interview
IET	1	Barcelona	Manufacturing	Interview
IETI	2	Barcelona	Open to all families	Interview, Focus Group, Observation

ITV	13	Lleida	Building and works, Open to all families	Interview, Focus Group
IMDM	7	Barcelona	Image and Sound, Mechanical Manufacturing	Interview, Focus Group, Observation

3.1. Methodology in the ATC Classroom

The codes within this category have been developed to examine the research question: What methodological aspects are relevant for vocational education and training (VET) teachers regarding digital competence in using ATC? These codes have been pre-established to encompass the viewpoints and issues of participants regarding the Monitoring, Assessment, and Working Plans associated with ATCs.

3.1.1. Monitoring

Integrating the Applied Technology Classroom requires alignment with educators' teaching digital competence, demanding comprehensive training to optimise implementing innovative technologies within the educational environment (IC). Emphasising the alignment of technology with educational objectives and educator preparation is crucial to ensure its appropriate utilisation and efficacy in enhancing student learning (IBF). It is imperative to underscore the indispensability of training and proficient use of technology within the classroom (IET). This forces the provision of enhanced training initiatives and specialised programs to maximise the use of available tools (ITV). Educators must cultivate teaching digital competencies to augment pedagogical practices and foster professional development by leveraging technology within the educational setting.

> *ITV: "If we do not undertake training, we cannot promote the use of this classroom either… …Therefore, you require extensive training because, for example, when designing a class using new technologies, you need to have considerable mastery of the new technology for it to proceed well…".*

The focal point of the ATC's digital initiative is to enhance students' digital proficiency using cutting-edge technologies, including 3D printers and virtual reality (IC). The ATC is a dedicated environment for fostering experiential learning in disciplines such as technological proficiency (ITV, IETI). Despite resource constraints, the primary objective is to maximise the efficacy of these technologies and seamlessly embed digital competencies within the established curriculum.

> *IMDM: "…For example, artificial intelligence is now the most evident example. It permeates us fully. This fully means that now, with the generative measure, you can generate a volume of content that until now was very systematised, within image and sound by scale… The Technology Classroom, after all, is just one more piece of equipment for a broader digital transformation of all processes. It is one more element."*

The institutions prioritise integrating technology into educational frameworks, training educators, and equipping students for the digital era (IBF). This emphasises the significance of technological investment and underscores the necessity of addressing fundamental digital literacy and programming skills (IC1). The

ATC Classroom constitutes an integral component of a comprehensive digital initiative within the educational institution.

> ***IETI1:*** *"Well, …We want to train teachers and students as much as possible in new technologies. Therefore, from here, we are experimenting, we are doing projects, we are making small pills for teacher training or even information. …it is not just another learning tool; in its proper measure, it can serve for children to learn more. Therefore, it is okay".*

3.1.2. Assessment

Numerous projects have been undertaken within the ATC, focusing on technology, simulation, virtual reality, and industrial design (IET). These initiatives encompassed involvement in the Building Olympics, podcast production, educational innovation endeavours, and external competitions (IETI, IC). The technological infrastructure of the classroom has facilitated a wide array of activities and partnerships with institutions and businesses.

> ***IBF:*** *"…Within the Computer Science family, one of the Ministry's projects on our part was to program a video game that was used with virtual reality. The fact that we had glasses allowed us to participate in this ministry project. Using the industrial line has created one more space that gives us flexibility in adapting the centre to accommodate more initiatives… Moreover, having a high-tech industrial line enables students to be better prepared to participate in this type of project."*

Utilising technological advancements in education emphasises the significance of fostering student motivation through avant-garde tools (IMDM). It also underscores the concept of perpetual learning and the indispensable role of educators in guiding the educational journey (ITV). Furthermore, it accentuates the pivotal nature of proficient training in utilising technological apparatus and expounds upon the notion that the pursuit of knowledge knows no bounds.

> ***IET:*** *"…ATC has three fundamental things for me. The first is that it is a different space from a school. So, this is key at the level of motivation because you take it out of what the day-to-day is… The second point is technology. It is a classroom where you must do everything. So, there is no excuse to do things with laptops or connect to the virtual network. The third is that it is such a multipurpose space that you can do different dynamics simultaneously".*

In short, collaboration in intercycle projects between unknown students helps to develop social skills and encourages socialisation. These projects also promote autonomy and the development of skills such as leadership and problem-solving (IMDM). Spaces like the ATC classrooms provide technological resources and motivate students, allowing experimentation and creativity (ITV). In addition, working as a team and facing challenges in a group strengthens social skills and encourages social interaction.

> ***IETI:*** *"…So this does change, and this motivates them because, in the end, they leave their comfort zone. However, I have detected that they still need the teacher to be the axis of the process."*

3.1.3. Working plan

The ATC Classroom is conducive to executing student and educator initiatives utilising project-based methodology (IC). Its primary objective is to equip students with the necessary skills to remain abreast of technological advancements in the continuously evolving employment landscape.

> *IBF: "Yes, …the labour market is growing technologically faster than the educational system. So, these investments allow us not to catch up but to get closer at a technological level to the technologies used in the world of work. And then, when students leave the institution, they do not start from scratch but start from the use of those technologies that give that added value to companies or that companies value when betting on students from your school if they have used these cutting-edge technologies".*

By exposing students to cutting-edge technologies, the ATC Classroom bestows them a competitive edge, furnishing them with an expanded arsenal to distinguish themselves within the labour market (IET). Additionally, it allows them to accumulate practical, hands-on experience, which can be prominently featured on their resumes (ITV, IMDM). The ATC Classroom is dedicated to readying students for the contemporary professional sphere by replicating the settings and technologies they are poised to encounter in their forthcoming careers.

> *ITV: "The idea is to bring closer to the reality of companies, the labour market, and the jobs of these students, and bring it closer to the classroom with different applications and methodologies. This is a small quantity of creating virtual environments that simulate what they will find outside. In the end, it is a bit about trying to make the transition to the labour market with the greatest possible advantages, with the greatest possible training, with the closest possible reality that they will find a posteriori".*

4. DISCUSSION

This research seeks to determine the relevant methodological aspects for vocational education and training (VET) teachers using ATC. The primary organisational transformation entailed the establishment of the ATC Classroom, demanding the synchronisation and administration of all newly acquired apparatus and technologies. Furthermore, this implementation has notably transformed educational spaces at the vocational education and training (VET) level (España Ministerio de la Presidencia Relaciones con las Cortes y Memoria Democrática, 2020), facilitating dynamic presentations, collaborative group work, and the application of interactive teaching methodologies. From an administrative standpoint, its integration needs meticulous oversight and authorisation, particularly in managing health-related emergencies. Furthermore, the ATC Classroom has proven to be a versatile resource for various activities, including presentations, meetings, and post-production work, alleviating the burden on traditional recording studios (España Dirección General de Formación Profesional, 2022; Kumótica, 2022).

The recent use of the educational space has sparked significant interest and inquiry regarding its practical application (Gomez-Garcia et al., 2022). The ATC classroom has garnered considerable attention, leading to substantial recommendations for its effective implementation (Montero-Izquierdo et al., 2024). Active efforts are being made to forge partnerships with corporate entities to transform the classroom into a focal point for technological innovation.

Table 3 provides a comprehensive analysis and discussion of the participants' considerations regarding the methodological aspects relevant to VET teachers regarding digital competence in using ATC and the monitoring, assessment, and work plan aspects. This table also integrates their perspectives with pertinent theoretical frameworks from established scholarly literature.

Table 3. *Analytical Exploration of the Participants' Perspectives.*

Research Questions	**What methodological aspects are relevant for vocational education and training (VET) teachers regarding digital competence in using ATC?**		
Category	Codes	Sub-codes	Discussion on Participants' Perspectives
Methodology in the *ATC* Classroom	Monitoring	1. Achievement of Intended Objectives	The applied technology classroom aims to enhance digital competence in vocational education and training. This approach promotes interaction among learners, fostering creative thinking and problem-solving skills tutelage (Brunet & Rodríguez-Soler, 2014; Fandos-Garrido et al., 2017). By integrating advanced technological tools, the curriculum encourages the acquisition of essential digital competences and collaborative learning, which are indispensable for success in a rapidly evolving vocational landscape (Alemán Falcón, 2015; Carvajal Larenas et al., 2017; Samuel et al., 2020). It is recommended that the ATC classroom be leveraged more extensively, with increased courses offered, supported by specific training and personnel dedicated to teaching these technologies (Cateriano-Chavez et al., 2021). Equipping teachers and students with the skills needed for new technologies is vital for generating interest and fostering collaboration (Sánchez Prieto et al., 2020; Suárez-Guerrero et al., 2021).
		2. Teaching Digital Competence	Continuous training is essential for effectively utilising technologies in the classroom. Motivation catalyses both learning and professional engagement. A teacher's digital competence opens more significant opportunities for practical knowledge acquisition (Casal-Otero et al., 2021; Cisneros-Barahona et al., 2023; Romero-García et al., 2020).
	Assessment	3. Related projects	Various projects can be undertaken in the fields of virtual reality and additive manufacturing, including training with virtual laboratories and engaging in competitions like the Building Olympiad (Suárez-Guerrero et al., 2021). Activities involving 3D printing, virtual reality, and participation in events such as the 24-hour inter-center challenge have also taken place (Bacca et al., 2019). Additionally, models for mental health initiatives and live streaming projects have been developed. Within the classroom, competitions such as the Building with Ingenuity Olympics have been held, alongside training in motion capture and 3D animation.
		4. Creativity, innovation, professional activity	The ATC classroom fosters the development of essential social and technological skills, alongside motivation and creativity in students (Manzano-Sánchez et al., 2021). The interdisciplinary

		projects and activities promoted in this environment encourage social interaction and collaboration among peers (Brunet & Rodríguez-Soler, 2014). Furthermore, the significance of persistence and teamwork in overcoming technological and creative challenges is emphasized. The cooperation and interaction among students from various disciplines on joint projects is also highly beneficial (Sánchez et al., 2018).
	5. Methodological changes	There are key points to using technology effectively in the ATC classroom: it changes the methodology and motivates students to leave their comfort zones (Exposito-Lopez et al., 2021). Technology motivates students, especially by allowing them to capture movements and create exciting projects. Students must be the main axis of the learning process, but guidance from the teacher is also needed (Domingo-Cebrián, 2021). Proper training in the use of technology is essential to ensure its correct functioning and durability. Technology is a useful tool for teaching and motivating students and encouraging self-learning.
Working Plan	6. Work Environment	The ATC Classroom provides students with a technological advantage in the job market through hands-on experience in innovative projects and rapid adaptation to new technologies (García-Gómez et al., 2016). Its project-based methodology offers tailored tools to meet the specific needs of each initiative. This training is essential for distinguishing oneself in a resume and equips students with practical skills that bridge the gap between academia and the workforce (San-Martín & Miranda, 2020). By focusing on advanced technologies, the program prepares students for current labour market demands, giving them a competitive edge.

5. CONCLUSIONS

The integration of advanced technologies, such as 3D printing, virtual reality, and laser cutting, within the educational environment of ATC is intended to transform and modernise vocational education. This strategic integration may revolutionise pedagogical approaches, empowering students to engage in experiential learning and directly apply theoretical concepts. Consequently, this paradigm shift can effectively equip learners with enhanced preparation for the demands of the dynamic and rapidly evolving contemporary employment landscape. Even so, a fundamental challenge that has been identified pertains to the imperative need for Vocational Education and Training (VET) teachers to improve Teaching Digital Competencies. Despite implementing digital mentors and training initiatives, educators' practical digital instructional abilities and official certifications still need to be addressed. This underscores the requirement for a more organised framework for validating digital competence and providing customised training.

The effective integration of digital technologies in ATCs demands comprehensive teacher training to ensure educators possess the requisite digital competencies. The success of these classrooms depends on teachers being proficient in using advanced tools such as 3D printers, virtual reality, and digital whiteboards. Moreover, there is an urgent requirement for tailored training programs designed to equip educators with the skills necessary to incorporate technology into their teaching practices confidently. By receiving this training, educators can maximise the potential of the digital tools at their disposal, thereby enhancing the learning experiences for their students. Integrating technology into educational settings necessitates a

fundamental transformation in teaching methodologies. ATCs may create dynamic, project-based learning environments where students can engage with technological hands-on activities. This boosts their motivation and social abilities and provides lifelike simulations that resemble real-world work scenarios.

The symbiotic relationship between vocational education and training (VET) institutions and industry partners is crucial in aligning ATCs with real-world demands. These strategic partnerships play a pivotal role in acquainting students with industry-standard technologies and practices, guaranteeing that their educational experiences directly cater to the requirements of employers, especially in domains such as mechanical manufacturing and healthcare technology. These partnerships not only enhance the quality of education but also ensure that students are well-prepared to meet the evolving needs of the industry. This collaboration is essential for producing job-ready graduates who can make an immediate impact in their chosen fields.

The imperative need for investments in Applied Technology Classrooms, particularly in cutting-edge technologies such as virtual reality and industrial simulations, cannot be overstated. These investments are crucial for giving students a distinct advantage in the labour market. The practical experiences gained through these technologies enhance their skill set and equip them with directly applicable high-demand skills. By investing in ATCs, educational institutions position their students competitively and ensure they are well-prepared to meet the needs of the modern workforce.

It is imperative to acknowledge that establishing ATC Classrooms necessitates substantial organisational changes within educational institutions. These transformations include creating new roles, such as project coordinators, logistical adjustments to accommodate high-value equipment, and significant resource allocation for training, maintenance, and operational costs. The successful implementation of ATCs hinges on strategic management and sustained investment in infrastructure and human resources. Therefore, educational institutions must recognise the critical nature of these investments and take proactive steps to integrate ATCs into their curricula.

The dynamic layout and resources within ATCs are designed to provide educators with the tools to cultivate their students' creativity, problem-solving abilities, and critical thinking skills. This adaptability is essential for facilitating innovative teaching approaches, collaborative initiatives, and interactive learning experiences, all crucial for equipping students with the requisite skills to excel in today's rapidly evolving work environment.

6. LINKS

- Zenodos annexes: Here you will find the following different annexes.
  - Annexe 1- Dimensions Information Sheet.
  - Annexe 2- Fundamental coding scheme considered for enhancing rigour in thematic analysis.
  - Annexe 3- Intrument 1- Interview.
  - Annexe 4- Instrument 2-Focus group.
  - Annexe 5- Instrument 3-AtecA Room Observation Grid
  - Annexe 6- Informed consent form.

7. RESEARCH ETHICS

The Ethical Committee for Research on People, Society and the Environment of the Universitat Rovira I Virgili has validated these instruments with identification code CEIPSA-2023-TDO-0032. Participants were given the Consent Information Sheet (see annexe 6).

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9. REFERENCES

Alemán Falcón, J. A. (2015). The dual system in the German vocational training: School and enterprise [El sistema dual de formación profesional alemán: Escuela y empresa]. *Educacao e Pesquisa*, *41*(2), 495–511. https://doi.org/10.1590/s1517-97022014121532

Bacca, J., Baldiris, S., Fabregat, R., & Kinshuk. (2019). Framework for designing motivational augmented reality applications in vocational education and training. *AUSTRALASIAN JOURNAL OF EDUCATIONAL TECHNOLOGY*, *35*(3), 102–117. https://doi.org/10.14742/ajet.4182

Borden-Lanza, y., Lores-Gómez, B., Usart-Rodríguez, M., & Colobrans-Delgado, J. (2023). Competencia digital y formación profesional en España: análisis documental sobre su regulación, propuestas y recomendaciones. *Hachetetepé. Revista Científica de Educación y Comunicación*, *26*. https://doi.org/10.25267/Hachetetepe.2023.i26.1204

Brunet, I., & Rodríguez-Soler, J. (2014). Vocational training and innovation: Research on innovation transfer between VET schools and enterprises [Formación Profesional e innovación: Estudio de la transferencia de innovación entre centros de FP y empresas]. *Revista de Educacion*, *365*, 177–201. https://doi.org/10.4438/1988-592X-RE-2014-365-269

Cardoso, A., Guimaraes, P. N., Dinis, A. P., Koukovinis, A., Domenech-Pastor, J., Segado, A., Dascalu, M., & Olaru, S. (2020). Updating the Clothing Technician Profile through synergies between industry and vocational and educational training. *INDUSTRIA TEXTILA*, *71*(6), 587–595. https://doi.org/10.35530/IT.071.06.1838

Carvajal Larenas, R. P., J, R. A., & Gustavo, Á. (2017). Estrategia para Contribuir a la Implementación de la Formación Dual de los Profesionales de Ciencias Empresariales en las Pequeñas y Medianas Empresas de la Provincia Tungurahua, Ecuador. *Formación Universitaria*, *10*(5), 29–40. http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718-50062017000500004

Casal-Otero, L., Barreira Cerqueiras, E. M., Mariño Fernández, R., & García Antelo, B. (2021). Competencia Digital Docente del profesorado de FP de Galicia. *Pixel-Bit, Revista de Medios y Educación*, *61*, 165–196. https://doi.org/10.12795/pixelbit.87192

Cateriano-Chavez, T. J., Rodríguez-Rios, M. L., Patiño-Abrego, E. L., Araujo-Castillo, R. L., & Villalba-Condori, K. O. (2021). Digital skills, methodology and evaluation in teacher trainers | Competencias digitales, metodología y evaluación en formadores de docentes. *Campus Virtuales*, *10*(1), 153–162. http://www.uajournals.com/ojs/index.php/campusvirtuales/article/view/673/437

Cervera, M. G., Martínez, J. G., & Mon, F. M. E. (2016). Competencia digital y competencia digital docente: una panorámica sobre el estado de la cuestión. *Revista Interuniversitaria de Investigación En Tecnología Educativa*, *0*, 74–83. https://doi.org/10.6018/riite2016/257631

Cisneros-Barahona, A. S., Marqués Molías, L., Samaniego Erazo, N., & Mercedes, C. (2023). La Competencia Digital Docente. Diseño y validación de una propuesta formativa. *Pixel-Bit, Revista de Medios y Educación*, *68*, 7–41. https://doi.org/10.12795/pixelbit.100524

Cisneros-Barahona, A., Molías, L. M., Erazo, G. S., Uvidia-Fassler, M., de la Cruz-Fernández, G., & Castro-Ortiz, W. (2022). Teaching Digital Competence in Higher Education. A Comprehensive Scientific Mapping Analysis with Rstudio. In *Communications in Computer and Information Science: Vol. 1647 CCIS*. https://doi.org/10.1007/978-3-031-18347-8_2

Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, *12*(3), 297–298. https://doi.org/10.1080/17439760.2016.1262613

Creswell. (2014). *Research-Design_Qualitative-Quantitative-and-Mixed-Methods-Approaches*.

Del-Cerro-Velázquez, F., & Ramón-Cano, F. J. (2018). Formación Profesional: Requerimientos profesionales y ocupaciones laborales de la CNO-11. *Revista de Educación a Distancia (RED)*, *58*. https://doi.org/10.6018/red/58/9

Domingo-Cebrián, V. (2021). La Formación Profesional Dual en Aragó: visión empresarial del sector de atención a la dependencia. *REDIE*, *23*, 19. https://dialnet.unirioja.es/descarga/articulo/8238391.pdf

España Consejería de Educación Cultura y Deporte. (2021). *Orden 115/2021, de 20 de julio, de la Consejería de Educación, Cultura y Deportes, por la que se crean aulas de tecnología aplicada en determinados centros de titularidad pública de Castilla-La Mancha, que imparten enseñanzas de Formación Profesional y se determina la puesta en marcha y funcionamiento de las mismas. [2021/8595]*.

España Dirección General de Formación Profesional. (2022). *Instrucciones justificación económica Aulas ATECA 2022*. https://www.juntadeandalucia.es/educacion/portals/delegate/content/fad73f0d-73af-496d-9c56-bd06a9ad81be/Manual%20de%20justificaci%C3%B3n%20ATECA%2022-23

España Ministerio de la Presidencia Relaciones con las Cortes y Memoria Democrática. (2020). *Resolución de 29 de diciembre de 2020, de la Subsecretaría, por la que se publica Convenio entre el Ministerio de Educación y Formación Profesional, la Generalitat de Catalunya y la Entidad Pública Empresarial Red.es, M.P., para la ejecución del programa «Educa en digital», mediante acciones para apoyar la transformación digital del sistema educativo. Boletín Oficial de Estado, núm. 341, pp. 128451 a 128465*. https://www.boe.es/diario_boe/txt.php?id=BOE-A-2020-17407

Exposito-Lopez, J., Romero-Diaz de la Guardia, J. J., Olmedo-Moreno, E. M., Piston Rodriguez, M. D., & Chacon-Cuberos, R. (2021). Adaptation of the Educational Motivation Scale Into a Short Form With Multigroup Analysis in a Vocational Training and Baccalaureate Setting. *FRONTIERS IN PSYCHOLOGY*, *12*. https://doi.org/10.3389/fpsyg.2021.663834

Fandos-Garrido, M., Renta Davids, A. I., Jimenez Gonzalez, J. M., & Gonzalez Soto, A.-P. (2017). Analysis of learning and application of general competences in the labour context. Collaboration strategies

between vocational training, universities and enterprises. *EDUCAR*, *53*(2), 333–355. https://doi.org/10.5565/rev/educar.889

Fife, S. T., & Gossner, J. D. (2024). Deductive Qualitative Analysis: Evaluating, Expanding, and Refining Theory. *International Journal of Qualitative Methods*, *23*. https://doi.org/10.1177/16094069241244856

FPinnova. (2022). *Aulas AtecA*. https://fpinnova.grupo-ae.com/aulas-ateca/

García-Gómez, S., Ordóñez-Sierra, R., Mariscal, E. V, & Chaparro, R. I. (2016). Vocational education & training students' families' expectations about their future employment [Expectativas das famílias dos estudantes de formação profissional sobre seu emprego futuro] [Expectativas de las familias del alumnado de formación profesional acerca de su futuro laboral]. *Education Policy Analysis Archives*, *24*. https://doi.org/10.14507/epaa.24.2484

Gomez-Garcia, M., Alameda Villarrubia, A., Poyatos Dorado, C., & Ortega-Rodriguez, P. J. (2022). Future Classroom Lab: a project for the pedagogical redefinition of educational centers. *REVISTA INTERUNIVERSITARIA DE FORMACION DEL PROFESORADO-RIFOP*, *98*, 133–152. https://doi.org/10.47553/rifop.v98i36.2.94188

Harrison, Reilly, & Creswell. (2020). Methodological Rigor in Mixed Methods: An Application in Management Studies. *Journal of Mixed Methods Research*, *14*(4), 473–495. https://doi.org/10.1177/1558689819900585

INTEF. (2017, October). *Aula del Futuro: Instituto Nacional de Tecnología Educativa y Formación Profesional*. https://intef.es/tecnologia-educativa/aula-de-futuro/#:~:text=El%20Aula%20del%20Futuro%20es,el%20desarrollo%20competencial%20del%20alumnado.

Kumótica. (2022). *Aula AtecA: El Aula de Tecnología Aplicada*. https://kumotica.es/blog/robotica-educativa/aula-ateca-el-aula-de-tecnologia-aplicada

Maher, C., Hadfield, M., Hutchings, M., & de Eyto, A. (2018). Ensuring Rigor in Qualitative Data Analysis. *International Journal of Qualitative Methods*, *17*(1). https://doi.org/10.1177/1609406918786362

Martin, M. (2015). Competencias digitales: imprescindibles para el futuro. *Capital Humano*, *28*(303).

Manzano-Sánchez, D., Gómez-Mármol, A., Conte Marín, L., Jiménez-Parra, J. F., & Valero-Valenzuela, A. (2021). Future Academic Expectations and Their Relationship with Motivation, Satisfaction of Psychological Needs, Responsibility, and School Social Climate: Gender and Educational Stage. *International Journal of Environmental Research and Public Health*, *18*(9), 4558. https://doi.org/10.3390/ijerph18094558

Merino-Pareja, R., & García-Gracia, M. (2022). Vías e itinerarios de formación profesional: la persistencia de la asociación entre bajo rendimiento y opción profesional. *Estudios Sobre Educación*, *43*, 157–176. https://doi.org/10.15581/004.43.008

Ministerio de Educación y Formación Profesional. (2020). *Plan de Modernización de la Formación Profesional:Plan para la Formación Profesional, el Crecimiento Económico y Social y la Empleabilidad, Formando profesionales para el futuro*. https://www.todofp.es/dam/jcr:5d43ab06-7cdf-4db6-a95c-b97b4a0e1b74/220720-plan-modernizacion-fp.pdf

Montero-Izquierdo, A. I., Jeong, J. S., & González-Gómez, D. (2024). A future classroom lab with active and gamified STEAM proposal for mathematics and science disciplines: Analyzing the effects on pre-service teacher's affective domain. *Heliyon*, *10*(16), e35911. https://doi.org/10.1016/j.heliyon.2024.e35911

Moreno-Guerrero, A.-J., Lopez-Belmonte, J., Rozo-Sanchez, S., & Lopez-Nunez, J.-A. (2021). Usability and prospective of distance learning in Vocational Training determined by digital competence. *AULA ABIERTA*, *50*(1), 471–479. https://doi.org/10.17811/rifie.50.1.2021.471-480

Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A Step-by-Step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research. *International Journal of Qualitative Methods*, *22*. https://doi.org/10.1177/16094069231205789

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1). https://doi.org/10.1177/1609406917733847

Ojeda, P. A., Morales, L. G., & Albalat, J. Q. (2019). Competencias Digitales: Realidad de ingreso de los estudiantes a la vida universitaria. *Digital Education Review*, *36*. https://doi.org/10.1344/der.2019.36.68-84

Paz-Saavedra, L. E., & Gisbert Cervera, M. (2023). Autopercepción del profesorado universitario sobre la competencia digital docente. *Educar*, *59*(2), 437–455. https://doi.org/10.5565/rev/educar.1614

Pearse, N. (2019). An Illustration of a Deductive Pattern Matching Procedure in Qualitative Leadership Research. *Electronic Journal of Business Research Methods*, *17*(3), 143–154. https://doi.org/10.34190/JBRM.17.3.004

Rego-Agraso, L., Barreira Cerqueiras, E. M., & Rial Sanchez, A. F. (2015). Vocational Dual Education System: comparison between the German model and the new Spanish vocational training. *Revista españoa de educacion comparada*, *25*, 149–166. https://doi.org/10.5944/reec.25.2015.14788

Rego-Agraso, L., & Rial-Sánchez, A. (2017). Why choose vocational training? Satisfaction, motivations and expectations of trainees about employment and training [¿por qué elegir formación profesional? Satisfacción, motivaciones y expectativas del alumnado sobre el empleo y la formación]. *Revista Espanola de Orientacion y Psicopedagogia*, *28*(3), 43–62. https://doi.org/10.5944/REOP.VOL.28.NUM.3.2017.21618

Romero-García, C., Sacristán, M., Buzón-García, O., & Asencio, E. N. (2020). Evaluation of a program for the improvement of learning and digital competence in future teachers utilizing active methodologies | Evaluación de un programa para la mejora del aprendizaje y la competencia digital en futuros docentes empleando metodologías. *Estudios Sobre Educacion*, *39*, 179–205. https://doi.org/10.15581/004.39.179-205

Ros-Garrido, A. (2021). Planning concepts in vocational training programs: The importance of professional experience. *EDUCAR*, *57*(1), 65–80. https://doi.org/10.5565/rev/educar.1187

Sambró, J. C., García, N., Borden-Lanza, Y., & Lores-Gómez, B. (2023). *Transcripción Reunión ICE*.

Samuel, B., Cabrales Goitia, A., & Marcel, J. (2020). ¿Qué empresas participan en la formación profesional dual? *Papeles de Economía Española*, *166*, 94–104. https://www.funcas.es/wp-content/uploads/2021/01/Samuel-Bentolila-Antonio-Cabrales-Marcel-Jansen.pdf

San-Martín, S., & Miranda, J. (2020). *Aula AtecA. Aulas Tecnológicas: Visión de la Empresa*. https://www.todofp.es/dam/jcr:3a3ba5ac-b727-4ab9-95f5-11e4cb16855a/aulas-tecnologicas-ateca-empresas.pdf

Sánchez, P. A., De, R., Rodríguez, H., María, C., & Abellán, A. (2018). *Redes de apoyo y colaboración para la mejora de la educación inclusiva REDES DE APOYO Y COLABORACIÓN PARA LA MEJORA DE LA*

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Sánchez Prieto, J., Trujillo Torres, J. M., Gómez García, M., & Gómez García, G. (2020). Gender and Digital Teaching Competence in Dual Vocational Education and Training. *Education Sciences*, *10*(3), 84. https://doi.org/10.3390/educsci10030084

Soratto, J., Pires, D. E. P. de, & Friese, S. (2020). Thematic content analysis using ATLAS.ti software: Potentialities for researchs in health. *Revista Brasileira de Enfermagem*, *73*(3). https://doi.org/10.1590/0034-7167-2019-0250

Suárez-Guerrero, C., Ros-Garrido, A., & Lizandra, J. (2021). Approach to digital teaching competence in vocational training. *Revista de Educación a Distancia*, *21*(67). https://doi.org/10.6018/RED.431821

Verdú-Pina, M., Lázaro-Cantabrana, J. L., Grimalt-Álvaro, C., & Usart, M. (2023). El concepto de competencia digital docente: revisión de la literatura. *Revista Electrónica de Investigación Educativa*, *25*(e11), 1–13. https://doi.org/10.24320/redie.2023.25.e11.4586

Xu, W., & Zammit, K. (2020). Applying Thematic Analysis to Education: A Hybrid Approach to Interpreting Data in Practitioner Research. *International Journal of Qualitative Methods*, *19*, 160940692091881. https://doi.org/10.1177/1609406920918810

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