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Applied technology classrooms and digital competence in vocational education and training: design, elaboration and validation of an instrument for data collection

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ABSTRACT

Integrating Applied Technology Classrooms (ATC) into Vocational Education and Training (VET) in Spain has significantly changed the educational landscape. This study focuses on understanding the impact of ATC on VET in Spain, particularly the process of designing a data collection instrument to document strategies, challenges, and outcomes developed in ATC. The study used the Delphi method to collect data from an expert panel in two iterative rounds. Based on the study criteria, 25 individuals were identified and invited to participate in the Delphi process. The final sample of 9 experts participated in the Delphi panel and evaluated the instrument. The panel members were assigned to assess the instrument based on predefined criteria, including univocity, relevance, and importance. The Delphi results, the data collection instrument designed for the research, are considered practical and relevant. The experts involved in the assessment provided overwhelmingly positive feedback, with most items within the instrument receiving high scores (81% in univocity and 87% in relevance). By incorporating expert recommendations and implementing relevant modifications, the resulting instrument is of higher quality and increased relevance, ultimately contributing to greater validity and reliability of the research (3.78 average satisfaction).

Keywords: Educational technology, Educational Research, Applied Technology Classrooms, Vocational Training, Professional training.

Aulas de tecnología aplicada y competencia digital en la formación profesional: diseño, elaboración y validación de un instrumento de recogida de datos

RESUMEN

La integración de las Aulas de Tecnología Aplicada (AtecA) en la Formación Profesional (FP) en España ha transformado el panorama educativo. Este estudio se centra en el impacto del Aula AtecA en la FP, especialmente en el diseño de un instrumento para documentar estrategias, retos y resultados asociados. Utilizando el método Delphi, se recopilaron datos de un panel de expertos en dos rondas iterativas. Una muestra final de 9 expertos participó en el panel Delphi y evaluó los instrumentos. Los expertos evaluaron el instrumento según criterios de univocidad, pertinencia e importancia. Los resultados de Delphi mostraron que el instrumento es práctico y relevante, con puntuaciones altas en univocidad (81%) y relevancia (87%). La retroalimentación positiva de los expertos permitió incorporar recomendaciones y realizar modificaciones, mejorando la calidad y relevancia del instrumento. Esto contribuye a una mayor validez y fiabilidad de la investigación, reflejada en una satisfacción media de 3,78.

Palabras Clave: Tecnología educativa, Investigación educativa, Aulas de Tecnología Aplicada, Formación Profesional.

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1. Introduction

The integration of Applied Technology Classrooms (ATC) into Vocational Education and Training (VET) in Spain has transformed learning environments to align more closely with the labour market's demands (Departament D´Educació Generalitat de Catalunya, 2021). This integration aims to provide students with practical skills and critical competencies for success in rapidly advancing workplaces (Ministerio de Educación y Formación Profesional, 2020). European policymakers in VET sponsor projects to meet professional requirements, leading to more frequent structural makeovers of VET classrooms (Brunet Icart & Rodríguez Soler, 2016). ATC exemplifies the European community's efforts toward VET strategic transformation. ATC in VET education helps bridge the gap between theoretical knowledge and practical industry experience, providing hands-on experience, enhancing problem-solving skills, and improving employability (Aulas ATECA, 2023; San Martín & Miranda, 2020).

The ATC has become a cornerstone platform for VET students to acquire practical experience with state-of-the-art Digital Technologies (DT) and progressive teaching techniques in Spain (Borden-Lanza *et al.*, 2023; Cattaneo & Aprea, 2018). Educators emphasise the significance of hands-on skill acquisition and practical applicability in the real world by integrating emerging tools such as augmented reality, virtual reality, and digital simulations into their curriculum (Mercader & Gairín Sallán, 2017; Vargas, 2019). ATCs play a vital role in providing an environment that promotes collaboration, creativity, and problem-solving skills among students, aligning with the ever-changing demands of the modern workforce (Aguilar Gonzálvez, 2015; Igartua Miró, 2017; Jalil, 2018; Montero-Izquierdo *et al.*, 2024). Implementing ATC in VET is intended to establish comprehensive ecosystems that use DT to enhance the digital proficiency of VET students and address technological challenges in contemporary enterprises. VET teachers must assimilate a more techno-pedagogical approach in their teaching methodologies to establish a symbiotic connection between the classroom and the real-world workplace (Commission *et al.*, 2017; Consejería de Educación Cultura y Deporte, 2021).

The role of Digital Competence (DC) in education and employment is crucial, leading to its integration into VET curricula (Cisneros-Barahona *et al.*, 2023; Lázaro-Cantabrana *et al.*, 2019). The ongoing enhancement of TDC signifies a pivotal juncture and a reorganization of the Vocational Education and Training (VET) Centre's Digital Projects (Esteve-Mon *et al.*, 2016; INTEF, 2017; Verdú-Pina *et al.*, 2023). In 2012, Europe saw the establishment of the Future Classroom Labs and the Ground-breaking Classroom. The founding of the ATCs in Spain was a strategic response aimed at modernising the educational system. All these technological spaces are intended to equip the future Spanish workforce with digitisation, innovation, and entrepreneurship skills (INTEF, 2017).

These initiatives are currently tasked with converting a conventional VET classroom into an Advanced Technological Classroom (ATC) and emulating specialised ecosystems rooted in Digital Transformation (DT) (Casal Otero *et al.*, 2021; Suárez Guerrero *et al.*, 2021). Recent studies emphasize the importance of enhancing the digital competence of VET teachers to create effective learning environments (Cateriano-Chavez *et al.*, 2021; Usart Rodríguez *et al.*, 2020). Additionally, VET teachers guide learners in understanding complex concepts and making informed choices, requiring them to enhance their digital competence skills (INTEF, 2017).

1.1 State of the Art of Digital competence of VET teachers

The literature underscores the key role of Vocational Education and Training (VET) teachers in effectively integrating Digital Technologies to enhance educational quality and equip students with valuable skills for the digital era (Larraz, 2013; López-Belmonte *et al.*, 2020; Suárez Guerrero *et al.*, 2021). Scholars emphasise the necessity for VET teachers to attain and maintain a high level of digital proficiency to improve pedagogical practices and student outcomes (Borden-Lanza *et al.*, 2023; Casal Otero *et al.*, 2022; Morales *et al.*, 2020). Recent studies reveal that educators with heightened DT are more likely to adopt pedagogical approaches that successfully integrate digital technologies, emphasising the importance of enhancing teachers' digital skills and knowledge to impact the quality of education they provide (Lázaro-Cantabrana *et al.*, 2019; Ros-Garrido, 2021; Sánchez-Prieto *et al.*, 2021).

Furthermore, the significance of Applied Technology Classrooms (ATCs) in VET is highlighted (Dirección General de Formación Profesional, 2022), yet there is limited research on their impact. It is essential to develop a comprehensive understanding of ATCs and identify potential gaps to address challenges in DT integration through these spaces. Moreover, it is imperative to investigate the impact of ATCs on VET teachers' Teaching Digital Competence (TDC) and acknowledge the potential of ATCs to update VET and equip students with crucial skills for the job market.

This study aims to thoroughly understand the use of ATC in VET in the Spanish context. The specific objectives of this study were:

OE1. Measure the clarity and relevance of the items of the instrument
OE2. Evaluate the degree of satisfaction with the implemented changes to have a final instrument version.

2. Methodology

The following methodologies and strategies were utilised for this specific part of the study to accumulate and assess data, engaging a diverse cohort of professionals:

- The preliminary stage involved a previously conducted systematic and documentary literature review (Borden-Lanza *et al.*, 2023).
- Succulently, an expert judgement that employed the Delphi method was applied in two successive rounds (Cabero-Almenara *et al.*, 2021; Cisneros-Barahona *et al.*, 2023; Molero-Aranda *et al.*, 2022).

Such approaches were pivotal in acquiring robust, high-quality data, contributing to the study's validity and reliability.

2.1. Literature review and analysis

The research began with a thorough review of documents using content analysis to compare official documents. The data collection took place between July and September 2022, focusing on reforms and investments related to TDC certification, accreditation, recognition, and DC training (Bisquerra, 2004; Cohen *et al.*, 2018).

A systematic literature review (SLR) was conducted using PRISMA-P guidelines to investigate DC levels among VET teachers (Borden-Lanza *et al.*, 2023). A pre-established search protocol with strict inclusion and exclusion criteria was implemented to ensure the rigour and quality of the SLR. The PRISMA-P guidelines were used to describe the identification, screening, eligibility, and inclusion criteria of the publications analysed, ultimately facilitating the development of robust results, discussion, and conclusions (Hutton *et al.*, 2016; Moher *et al.*, 2009; Urrútia & Bonfill, 2010).

2.2. Sample and Procedure of the Delphi Study

The Delphi method, involving a double iteration process, was utilised to select a panel of experts with relevant expertise in Applied Technology Classrooms (ATC) and Teaching Digital Competencies (TDC). The first round measured the clarity and relevance of the instrument's items, and the second round was conducted to evaluate the degree of satisfaction with the implemented changes to have a final version of the instrument.

A rigorous sample selection is needed to have valid results in this Delphi study. A non-probabilistic, intentional sampling method was conducted based on academic qualifications, professional experience, and demonstrated expertise on ACT and/or TDC as practitioners in academics. This led to an initial pool of 25 experts (see Additional Material). This process was followed to ensure the credibility and robustness of the subsequent Delphi study (Cabero Almenara & Moro, 2014; Cisneros-Barahona *et al.*, 2023; Escobar-Pérez & Cuervo-Martínez, 2008; López-Gómez, 2017; Molero-Aranda *et al.*, 2022).

After identifying the 25 profiles, the selected participants were invited to partake in the study. However, due to experts' negative or non-existent answers (N = 10) and the study's time limitations (N = 4), a sample of 11 responded, and finally 9 participated in the two phases of the Delphi study (see Table 4).

The representation of various stakeholder groups, such as educators, researchers, and practitioners, enriched the deliberations with a breadth of viewpoints, further enhancing the study's insights regarding technology integration in vocational education and training settings (Powell, 2003). Furthermore, based on Burguet Lago & Burguet Lago (2020) and López-Gómez (2017), the sample size, between 8 and 15 experts, was deemed appropriate for facilitating robust discussions and efficient data collection and analysis.

2.3. Data Collection and Data Analysis

The data collection procedure in this Delphi study involved double iterative rounds of soliciting feedback from an expert panel regarding the initial draft of the data collection instrument. The first mechanism, known as the Expert Biogram (Table 1), assessed the candidates' qualifications and expertise, including various sources of knowledge and criteria (Cabero-Almenara *et al.*, 2021; Cisneros-Barahona *et al.*, 2023; Molero-Aranda *et al.*, 2022). The second mechanism involved the application of the Expert Competence Coefficient (ECC) to assess the level of expertise of the experts. These mechanisms aimed to identify individuals with the requisite knowledge and experience to provide valuable insights and recommendations to the expert panel (Burguet Lago & Burguet Lago, 2020; Cabero Almenara, 2013; Cabero-Almenara *et al.*, 2021; López-Gómez, 2017; Martínez *et al.*, 2012; Paris *et al.*, 2018).

Table 1.
Expert Biogram: Informative Facts from the Experts. Own elaboration.

Please fill in the blank spaces with the information required.	
a)	Institutional responsibility:
b)	Institution:
c)	Gender:
d)	Studies carried out related to the research objective:
e)	Professional experience:
f)	Years of teaching at the University:
g)	Province and University where he currently works:

The coefficient *K*, also called the *ECC*, is a metric that quantifies an individual's self-assessed proficiency in a particular field. Hence, the is calculated by employing the equation), where kc denotes the individual's level of knowledge in the field, and ka denotes their level of awareness of the limits of their knowledge. The resultant metric is a score that ranges from 0 to 1, with a score of .8 or higher indicating a high level of competence. The ECC scale is a valuable tool that can be used to classify an expert's level of proficiency as either high, medium or low, thereby enabling a better understanding of their level of expertise (Cabero-Almenara & Barroso Osuna, 2013; Cabero-Almenara *et al.*, 2021; Mira *et al.*, 2010).

The parameter , also known as the knowledge coefficient (as per Table 2), is derived from the expert evaluation of the research topic on a scale ranging from 0 to 10. The numerical value obtained from this assessment is then multiplied by 1 to reflect the importance of the research topic. This methodology is widely accepted in academic circles and is a reliable means of evaluating the significance of a research area (Cabero-Almenara *et al.*, 2021; Cisneros-Barahona *et al.*, 2023; Mira *et al.*, 2010; Sariol *et al.*, 2018).

Table 2.
Kc-related values and indicators. Own elaboration.

Please indicate on a scale of 0 to 10 how familiar you are with Applied Technology Classrooms. This includes knowledge of teaching and learning processes, as well as methodologies that can be implemented in classrooms where digital technologies and levels of digital competence teaching are incorporated.
A score of 0 means you have absolutely no knowledge, while a score of 10 means you have full knowledge of the state of the classroom.

0	1	2	3	4	5	6	7	8	9	10

The expert's self-evaluation process produces the argumentation coefficient, denoted as in Table 3. This coefficient is based on the expert's assessment of their skill in utilising different sources of argumentation relevant to their expertise. The coefficient is a numerical representation of the expert's proficiency in effectively employing argumentation within their field of study (García & Fernández, 2008; Sariol *et al.*, 2018).

Table 3.
Sources of Argumentation and Degrees of Influence for Calculating K.
Source: (Cisneros-Barahona *et al.*, 2023; Molero-Aranda *et al.*, 2022).

Please, self-assess the degree of influence that each of the following sources has had on your knowledge and criteria on the following topics: incorporating digital technologies in teaching and learning processes, design of digital educational resources, and digital inclusion.			
Source of argumentation	Degree of influence of the sources on your criteria		
	High	Medium	Low
Training (initial or ongoing)	.20	.15	.10
Experience obtained by your professional activity.	.50	.40	.25
Participation and/or collaboration in research or innovation projects.	.05	.05	.03
Theoretical analysis of the subject.	.03	.02	.02
Intuition about the topic addressed.	.22	.18	.10
Total	1.00	.80	.50

2.4. Delphi implementation

The panel members were given various documents during the first round. These documents included a brief description of the study (annexe 1), a description of the literature used for constructing the categories, subcategories, indicators, and items (annexe 2), a prototype of the instrument (annexe 3), and an assessment sheet (annexe 4) with clear instructions for reviewing its content and structure. The panel evaluated the instrument based on specific criteria and provided feedback. The feedback was analysed, and a report outlining the modifications was shared with the experts. A second round of evaluation was initiated, and Microsoft Forms was used to collect feedback on the template changes. The study concluded with a report thanking the experts for their dedication.

3. Results

3.1. Literature review analysis and results

A comprehensive analysis of 11 official documents issued by the Spanish state has provided valuable insights into establishing and operating Applied Technology Classrooms (ATC) for VET. This analysis identified vital decrees, resolutions, and funding provisions facilitating the creation and maintenance of these specialised classrooms. A systematic literature review also emphasised the importance of Digital Teaching Competence (DTC) qualification and certification among Vocational Training teachers. The review revealed a need for more high-quality studies on this topic. It highlighted the need for research instruments to identify genuine levels of DTC and provide training proposals to improve DTC areas.

The utilisation of ATLAS.ti version 23.4.0 (29342) enabled the gathering of a diverse range of sources, including official documents and systematic literature (Borden-Lanza *et al.*, 2023), an interview with members of the Educational Sciences Institute of the Universitat Rovira i Virgili and the File of ATC in Castilla y La Mancha. Data was meticulously categorised and codified into various levels of analysis, such as categories (2), subcategories (7), indicators (15), and items (43) (see Figure 1). This approach ensured a rigorous and nuanced analysis of the data, which is essential for a thorough examination of the research question at hand (Gibson, 2017; Rueda Sánchez *et al.*, 2023; Vives Varela & Hamui Sutton, 2021). An internal analysis was conducted on the 43 items under consideration, which led to combining and refining them. This arduous process eventually culminated in creating version 0 of the data collection instrument, meticulously crafted and designed to contain 25 items representing the most salient and relevant aspects of the research subject matter (see annexe 3).

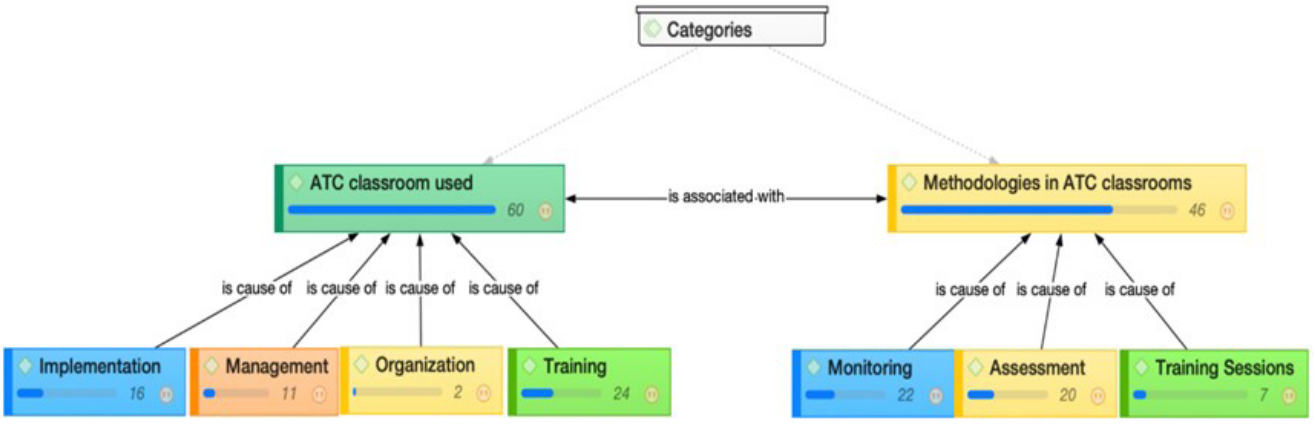

Figure 1. *Theoretical Support for Categorization and Coding of Categories, Sub-categories, Indicators, and Items. Own Source.*

3.2. Expert judgement

3.2.1. Coefficient K results

Based on the literature and other sources cited, 25 experts who met the required profile for the study were identified. These experts were then invited to participate in the Delphi process. Of the 25 experts, 9 accepted to be part of the Delphi panel to validate the instrument under consideration. Table 4 depicts the feedback from the experts.

Table 4.
Grade of Expert Knowledge Coefficient. Source: (Cabero-Almenara et al., 2021).

	Expert Code	Kc	Ka	k
Grade of Expert Knowledge Coefficient of the experts chosen for the Delphi study.	JLL	.7	1	.85
	TMA	.8	.9	.85
	LMM	.8	.86	.83
	MAL	.7	.9	.80
	JRL	.9	.96	.93
	VSM	.7	.9	.80
	CGA	.8	.95	.88
	VEG	.9	1	.95
	SMR	1.0	.9	.95

The estimation of K utilises the methodology for elaborating scientific-technical forecasts where .8< K < 1.0 means a high competence coefficient, .5 < K < .8 means average competence coefficient and K < .5 means low competencies (Cabero-Almenara & Barroso-Osuna, 2013; Cabero-Almenara *et al.*, 2021). The experts obtained an average *K* value = .87 (SD = .06), indicating a high competence coefficient to proceed to the Delphi rounds of evaluation of the instrument.

3.3. Instrument validation results

The results were analysed quantitatively to provide a descriptive view of the findings and qualitatively through the experts' observations of each section of the instrument. Table 5 shows the results obtained in the first and second Delphi rounds.

According to the data presented in Table 5, the experts have given highly positive assessments for the instrument section's univocity and relevance. The importance level results show that most of the instrument's items have obtained high punctuations, with an overall average/mean of 3.62%. Nevertheless, special attention has been given to some specific items *(I.7.2 C=3.22%, I.10.3 COP=3.44%, I.11.1 CDD=3.44%, and I.11.3 CDD=3.44%*), that received low averages. An in-depth analysis of the experts' comments was conducted to identify the areas that require modification before the second Delphi. The aim was to incorporate the experts' recommendations and make the necessary adjustments to enhance the instrument's second version's quality and relevance.

The evaluation conducted by the experts shows that their level of satisfaction with the implemented changes was remarkably high, with an average score of 3.78%. The assessment showed a significant improvement in the areas that received low scores in the initial evaluation, particularly in areas such as *I.7.2 C, I.10.3 COP, I.11.1 CDD, and I.11.3 CDD*. The scores for these items have improved significantly, with I.7.2 C and I.10.3 COP receiving a score of 3.89% and I.11.1 CDD and I.11.3 CDD receiving scores of 3.67% and 3.56%, respectively. It is worth noting that even though Item I.11.3 CDD received a score of 3.56%, the expert deemed the changes made to the item acceptable (see Figure 2).

The feedback from the experts indicates that the changes implemented have successfully improved the areas that required attention and have been deemed adequate by the experts (see Figure 2). The primary adjustments centre around providing additional information to enhance the phrasing of certain elements. Examples include the inclusion of "Organizational level" in item I.1.1ECF, a rewording of item I.7.1C, and replacing "Technological Spirit" with "the utilisation of digital technologies." Additionally, some experts requested further details to better articulate their viewpoints on specific items.

Table 5.
First and second Delphi Rounds. Adapted from: (Cisneros-Barahona et al., 2023; Molero-Aranda et al., 2022).

Template Indicators	First Round										Second Round					
	Univocality Percentages		Relevance Percentages		Importance				Average/ Mean	Standard Deviation	Satisfaction				Average/ Mean	Standard Deviation
	Yes	No	Yes	No	1	2	3	4	M	S	1	2	3	4	M	S
I.1.1ECF	67%	33%	100%	0%	0%	0%	22%	78%	3.78	0.44	0%	0%	22%	78%	3.78	0.44
I.2.1AC	56%	44%	100%	0%	0%	0%	33%	67%	3.67	0.50	0%	0%	22%	78%	3.78	0.44
I.3.1AE	89%	11%	100%	0%	0%	0%	67%	33%	3.33	0.50	0%	11%	33%	56%	3.44	0.73
I.4.1CI	78%	22%	89%	11%	0%	0%	22%	78%	3.78	0.44	0%	0%	11%	89%	3.89	0.33
I.4.2CI	100%	0%	100%	0%	0%	0%	33%	67%	3.67	0.50	0%	0%	11%	89%	3.89	0.33
I.5.1CAA	78%	22%	78%	22%	0%	0%	44%	56%	3.56	0.53	0%	0%	22%	78%	3.78	0.44
I.6.1ILAA	89%	11%	100%	0%	0%	0%	33%	67%	3.67	0.50	0%	0%	11%	89%	3.89	0.33
I.6.2ILAA	56%	44%	56%	44%	0%	0%	44%	56%	3.56	0.53	0%	0%	22%	78%	3.78	0.44
I.7.1C	67%	33%	78%	22%	0%	22%	33%	44%	3.22	0.83	0%	0%	11%	89%	3.89	0.33
I.7.2C	89%	11%	100%	0%	0%	0%	33%	67%	3.67	0.50	0%	0%	11%	89%	3.89	0.33
I.7.3C	67%	33%	78%	22%	0%	11%	22%	67%	3.56	0.73	0%	0%	11%	89%	3.89	0.33
I.8.1MD	100%	0%	89%	11%	0%	0%	33%	67%	3.67	0.50	0%	0%	11%	89%	3.67	1.00
I.9.1PFP	100%	0%	100%	0%	0%	0%	11%	89%	3.89	0.33	0%	0%	22%	78%	3.78	0.44
I.9.2PFP	67%	33%	100%	0%	0%	0%	44%	56%	3.56	0.53	0%	0%	11%	89%	3.67	1.00
I.10.1COP	78%	22%	89%	11%	0%	0%	22%	78%	3.78	0.44	0%	0%	0%	100%	4.00	0.00
I.10.2COP	100%	0%	100%	0%	0%	0%	22%	78%	3.78	0.44	0%	0%	11%	89%	3.89	0.33
I.10.3COP	56%	44%	89%	11%	0%	0%	56%	44%	3.44	0.53	0%	0%	11%	89%	3.89	0.33
I.11.1CDD	67%	33%	89%	11%	0%	11%	33%	56%	3.44	0.73	0%	0%	33%	67%	3.67	0.50
I.11.2CDD	100%	0%	89%	11%	0%	0%	33%	67%	3.67	0.50	0%	0%	0%	100%	4.00	0.00
I.11.3CDD	67%	33%	56%	44%	0%	0%	56%	44%	3.44	0.53	0%	0%	44%	56%	3.56	0.53
I.12.1PV	100%	0%	78%	22%	0%	0%	33%	67%	3.67	0.50	0%	0%	22%	78%	3.78	0.44
I.13.1CIAP	100%	0%	89%	11%	0%	0%	33%	67%	3.67	0.50	0%	0%	11%	89%	3.89	0.33
I.13.2CIAP	100%	0%	78%	22%	0%	0%	33%	67%	3.67	0.50	0%	0%	22%	78%	3.78	0.44
I.14.1CM	67%	33%	67%	33%	0%	0%	44%	56%	3.56	0.53	0%	11%	22%	67%	3.56	0.73
I.15.1ET	100%	0%	89%	11%	0%	0%	11%	89%	3.89	0.33	0%	0%	44%	56%	3.56	0.53

4. Discussion and Conclusions

The research provides a comprehensive understanding of the impact of Applied Technology Classrooms (ATC) on Vocational Education and Training (VET) in Spain, including the development and validation of a data collection instrument template. The study emphasises the necessity of rigorous research to gain insight into the complex relationship between ATC and VET, with the Delphi method employed to obtain expert judgment on the design and validation of the data collection instru-

ment. The feedback from experts was highly positive, leading to modifications to enhance the quality and relevance of the instrument's second version. These results can inform policy decision-makers and contribute to the academic discourse on technology integration in education.

Following the implementation of expert recommendations, the modified instrument demonstrated a significantly high satisfaction level. The assessment revealed notable improvements in areas initially receiving low scores, with substantial enhancements in corresponding items (Martínez *et al.*, 2012). Careful analysis of expert feedback led to necessary modifications, resulting in a more relevant and higher quality instrument, ultimately enhancing the research's validity and reliability (Gutiérrez-Castillo *et al.*, 2017).

Subsequently, the study will utilise this data collection tool to gather insights from VET professionals with experience in ATC deployment (Galicia Alarcón *et al.*, 2017; Hidalgo Cajo & Gisbert Cervera, 2021). This study aims to generate a significant educational impact by providing valuable insights into the individuals running ATCs. It seeks to bridge their pedagogical perspective with the potential focus of upcoming teacher training.

The forthcoming findings will inform the development of a comprehensive course proposal, if necessary, for effective ATC utilisation and equipping VET educators with the required skills and knowledge (Cisneros-Barahona *et al.*, 2023; Espinosa, 2013; Fonseca *et al.*, 2017). Furthermore, this proposal may facilitate the integration of ATC with other educational technologies, enhancing its utility for teaching and learning. Based on the research conducted following this framework, exemplified by the works of Sanromà-Giménez *et al.* (2021), Molero-Arando *et al.* (2002), and Cisneros-Barahona *et al.* (2023), it has been established that the application of such data collection tools and the consequent research outcomes are expected to yield substantial advantages for the VET community. This will, in turn, ensure the readiness of prospective students for achievement in the era of digitalisation.

The integration of ATC in VET in Spain has significantly transformed its educational framework, creating learning environments that meet the labour market's demands (Borden-Lanza *et al.*, 2023; San Martín & Miranda, 2020). ATCs bridge the gap between theoretical knowledge and practical industry experience, providing hands-on experience and practical skills applicable to the workforce. These spaces foster critical thinking and problem-solving skills and encourage student collaboration and teamwork. This integration prepares students for the workforce and meets labour market requests (Ministerio de Educación y Profesional, 2019; Gobierno de España, 2021).

The study's findings highlight the importance of digital competence (DC) in today's education and employment scenarios. Digital skills are crucial for individuals to navigate and contribute to a constantly evolving digital society. As a result, Applied Technology Classrooms (ATC) have been included in the VET curricula to provide students with practical experience in digital technologies and progressive learning techniques, including emerging tools such as augmented reality, virtual reality, and digital simulations (Brunet Icart & Rodríguez-Soler, 2014; Cattaneo & Aprea, 2018; Schwendimann *et al.*, 2015). This approach ensures students gain crucial skills and practical experience, making the ATC an indispensable and exchangeable platform for VET students in Spain and other countries. Therefore, individuals who possess digital skills are better equipped to remain competitive and relevant in the worldwide modern labour market (Cateriano-Chavez *et al.*, 2021; Lázaro Cantabrana & Gisbert Cervera, 2015; Gisbert Cervera & Lázaro Cantabrana, 2014; OECD, 2024; Rangel Baca, 2014).

VET teachers must prioritise developing digital competence skills to prepare students for success in the digital age. Proficient TDC is indispensable for educators to improve the quality of education and better equip students for the modern world (Cabero-Almenara *et al.*, 2020; Carvalho *et al.*, 2019; Castro-Granados & Artavia-Díaz, 2020; Cateriano-Chavez *et al.*, 2021; Gisbert Cervera *et al.*, 2016; Tejada & Pozos, 2018).

It is decisive to provide teachers with opportunities to improve their digital skills and knowledge to meet the diverse learning needs of their students. Addressing VET teachers' self-perceived limitations regarding their digital competence

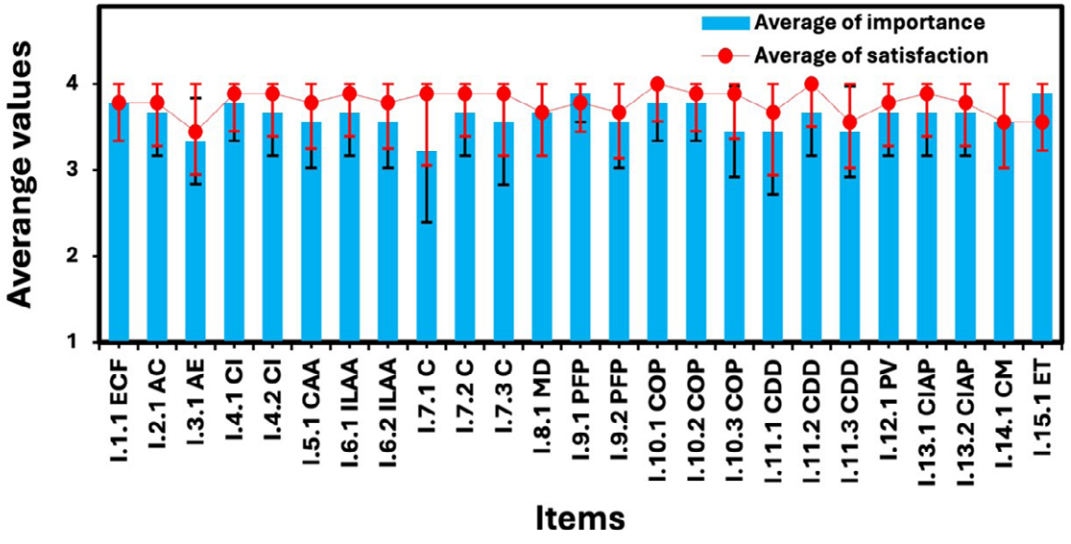

Figure 2. *Analysis of Items' Performance: average percentages and standard deviation values of importance and satisfaction. Own elaboration.*

levels is essential, as it can hinder their ability to embrace innovative pedagogical approaches and fully leverage technology in the classroom. This study emphasises the importance of examining the challenges encountered by VET teachers when integrating Digital Technology (DT) into their teaching practices through ATC spaces. Additionally, it highlights the need for comprehensive research to understand the impact of ATC on VET teachers' Teaching Digital Competence. Investing in research to gather accurate data on the effect of ATC on VET is critical for policymakers to improve the quality of education. This study contributes significantly to the existing literature by providing a detailed account of the research process and key findings.

The study's limitations are mainly associated with the sample size. Despite including a considerable number of experts in the selected cohort, the response rate could have been more optimal, and some participants self-evaluated themselves without possessing the required knowledge regarding the study's purpose. Although unintended, these limitations may have resulted in data bias and compromised the findings' credibility. Therefore, it is imperative to acknowledge these limitations and take appropriate measures to address them in future research studies to ensure the validity and reliability of the results.

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