Digital and methodological transformation of Vocational Education and Training in the post-COVID era

Transformación digital y metodológica de la formación profesional en la era pos-COVID

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Summary

In recent years, there have been various initiatives for the modernisation of Vocational Education and Training (VET) with regard to teaching strategies and the use of digital technologies. This study aims to analyse the digital and methodological transformation of VET that the pandemic may have generated. To this end, a sequential mixed methodology has been used, based on a survey of VET teachers (N=158) and interviews with 11 cycle coordinators during the 2021-2022 academic year. The results show that the most innovative teaching staff are women, young and involved in innovation projects. Also noteworthy is the increase throughout the pandemic in the variety of teaching strategies used by the teaching staff, with particular growth in active learning. Finally, there is a greater use of varied teaching strategies both on the teaching platform and in external tools. In conclusion, the pandemic has contributed to a transformation that had been trying to be activated for years. Keywords: educational strategies; digitalisation; vocational education and training; modernisation; digitalisation; digitalisation.

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Resumen

En los últimos años, han existido distintas iniciativas para la modernización de la Formación Profesional (FP) al respecto de las estrategias docentes y el uso de tecnologías digitales. Este estudio tiene por objeto analizar la transformación digital y metodológica de la FP que la pandemia haya podido generar. Con este fin, se ha utilizado una metodología mixta secuencial, basada en una encuesta a profesorado de FP (N=158) y entrevistas a 11 coordinadores/as de ciclo durante el curso 2021-2022. Los resultados demuestran que el profesorado más innovador es mujer, joven y con participación en proyectos de innovación. También destaca el incremento a lo largo de la pandemia en la variedad de estrategias didácticas que el profesorado usa, con especial crecimiento del aprendizaje activo. Por último, existe un mayor uso de estrategias didácticas variadas tanto en la plataforma docente como en herramientas externas. En conclusión, la pandemia ha contribuido a impulsar una transformación que llevaba años tratando de activarse.

Palabras clave: estrategias educativas; digitalización; Formación Profesional; modernización.

Introduction and objectives

The fourth industrial revolution has given rise to new ways of working, prompting the need to review educational processes and vocational education and training (VET) (Avis, 2020). The competences of both teachers and students in VET are being studied, highlighting the need for digital skills, creativity, critical thinking, knowledge management and teamwork (Wilson, 2019). In recent years, actions have been taken to train teachers in the use of didactic strategies and educational technology (OECD, 2021). Prior to the pandemic, the increasing incorporation of augmented reality, virtual reality, ubiquitous computing, collaborative technologies, extended reality, artificial intelligence and *blockchain* in VET had been observed (European Commission, 2020).

Numerous studies have analysed the impact of the global pandemic on the adoption of digital technologies and the necessary development of digital skills and flexible pedagogies in VET (e.g. Hume and Griffin, 2021). The biggest contribution of the pandemic to VET has been the adoption of technologies and distance learning (Pooja, 2021; Seyffer et al., 2022). However, it is noteworthy that evidence of diversification of teaching strategies has also been reported, showing a trend towards active learning (ILO, World Bank, UNESCO, 2021). In particular, flexible pedagogies (Zhao and Ko, 2020), the flipped classroom (Magetos et al., 2022), or participatory learning (Cox, 2022) are mentioned. Such evidence has led to a rethinking of the VET curriculum at European level, with a predominant approach based on competences, modularisation of content, flexibility, individualisation and emphasis on learning by doing and its impact on assessment systems (Cedefop, 2022). Consequently, different studies point to the need to continue the processes of digitisation and educational innovation in VET (European Commission, 2020; ILO, World Bank, UNESCO, 2021; Seyffer et al., 2022), with an emphasis on digital teacher training (OECD, 2021; Pooja, 2021).

In Spain, several studies have been carried out on the digital transition carried out as a result of the pandemic and its implications. García-de-Paz and Santana (2021) propose promoting the integration of digital technologies in the educational proposal, training students digitally and integrating digital teaching resources. Moreno-Guerrero et al. (2021) reveal a deficit in some areas of teachers' digital competence, which leads to a scarce use of online learning. Studies such as Casal et al. (2022) and Suárez-Guerrero et al. (2021) show that, although there are differences in the level of digital competence in all dimensions, significant progress has been made and teachers show a good attitude towards ICT. In this sense, teacher training is called for as a key to digital transformation and, consequently, to promote innovations in teaching-learning processes (Borden-Lanza et al., 2023; CaixaBank Dualiza and Orkestra, 2022; Moreno-Guerrero et al., 2021). Casal et al. (2022) call for more empirical evidence on the level of digital competence of VET teachers.

At the Catalan level, a documentary study on digital competence in teaching reveals that digital training is oriented more towards aspects of economic production than towards pedagogical aspects (Borden-Lanza et al, 2023). For his part, Nogueres (2021) concludes that it is not only the improvements brought about by the digitalisation of VET that need to be assessed, but also the shortcomings, especially accessibility and the change in personal relationships. In this sense, he argues that one of the main values that the pandemic has revealed is that of the face-to-face nature of educational interaction in VET. With regard to teaching strategies, there are some successful national experiences in the implementation of project-based learning (PBL) (Expósito and Moreno, 2021; Roselló and Viera, 2022) and challenge-based learning (de la Cruz, 2021) in VET. However, various voices call for further progress in relation to these strategies, as well as to theoretical-practical learning and active learning (Ministry of Education and Vocational Training, 2020). Féliz et al. (2022) point to the necessary methodological innovation resulting from the digital transformation in the application of e-learning in VET, suggesting more flexible teaching and active methodologies. For his part, González (2022) argues that the lack of economic resources and teacher training hinder greater innovation in VET classrooms, for example,
in the case of the use of game-based methodologies.

The literature review shows a clear interest in the digitisation of VET, often linked to teaching innovation, which translates into an increase in studies on the subject in the wake of the pandemic. International research calls for new studies on didactic aspects and training modalities (Echevarría and Martínez, 2021). The aim of this research is to analyse the digital and methodological transformation of VET in the wake of the pandemic. The specific objectives are: 1) to identify the profile of innovative VET teachers, 2) to determine the differences in the use of digital technologies for teaching throughout the pandemic and 3) to identify the teaching strategies implemented throughout the pandemic. The research questions that articulate this study are:

- What is the profile of VET teachers who use innovative teaching methodologies?

- Are VET teachers using digital technologies (institutional platform and external tools) more frequently for teaching in the wake of the pandemic?
- Has the diversity of teaching strategies (active, autonomous, situated and masterful) increased in VET in the wake of the pandemic?

Method

Population and Sample

In order to meet the objectives of this research, a sequential mixed methodology (Johnson et al., 2007) was applied by first conducting interviews with VET coordinators and then a questionnaire. This sequencing (Figure 1) was intended to gain a deeper understanding of the situation under study and to develop the most appropriate questions for the questionnaire; therefore, the qualitative results were used as a starting point for the questionnaire.
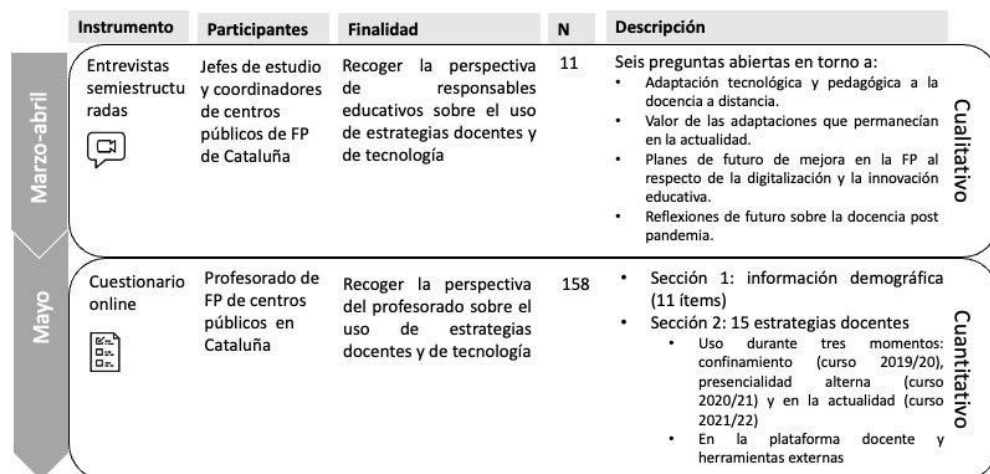
	Instrumento	Participantes	Finalidad	N	Descripción	
Marzo-abril	Entrevistas semiestructuradas	Jefes de estudio y coordinadores de centros públicos de FP de Cataluña	Recoger la perspectiva de responsables educativos sobre el uso de estrategias docentes y de tecnología	11	Seis preguntas abiertas en torno a: • Adaptación tecnológica y pedagógica a la docencia a distancia. • Valor de las adaptaciones que permanecían en la actualidad. • Planes de futuro de mejora en la FP al respecto de la digitalización y la innovación educativa. • Reflexiones de futuro sobre la docencia post pandemia.	Cualitativo

Mayo	Cuestionario online	Profesorado de FP de centros públicos en Cataluña	Recoger la perspectiva del profesorado sobre el uso de estrategias docentes y de tecnología	158	• Sección 1: información demográfica (11 ítems)
					• Sección 2: 15 estrategias docentes
					  • Uso durante tres momentos: confinamiento (curso 2019/20), presencialidad alterna (curso 2020/21) y en la actualidad (curso 2021/22)
					  • En la plataforma docente y herramientas externas
						Cuantitativo

Figure 1. Data collection process.

With regard to the collection of qualitative data, a selection of people with the profile of cycle co-ordination or head of studies was made from among the schools participating in the study (372 secondary and vocational training schools in Catalonia). Eleven participants were selected according to the following criteria: minimum three years' experience in the position, gender parity, schools of different sizes, schools teaching training cycles of different professional families, schools in different socio-economic contexts, schools with and without Dual modality (referring to the name of dual vocational training prior to LO 3/2022) and public schools.

The reference population for the collection of quantitative data was defined as intermediate and higher VET teachers in public schools in the Autonomous Community of Catalonia. The sample for the questionnaire was selected by

non-probabilistic sampling following a criterion of representativeness according to expert knowledge about the population (López-Roldán and Fachelli, 2017). The questionnaire was sent to teachers in 372 secondary and VET schools in Catalonia. A total of 191 responses were obtained, of which 158 were considered valid (82.72%). The following table (Table 1) shows the main characteristics of the sample.

Table 1

Sample characteristics.

Variable	Distribution
Gender	Female (48,1%), Male (51,3%), Prefer not to answer (0'6%)
Age	From 24 to 35 years old (21.5%), From 36 to 45 years old (36.7%), From 46 to 55 years old (27.8%), More than 56 (13.9%)
Years of VET experience	Less than 5 years (38.4%), between 6 and 10 years (19.8%), between 11 and 20 years (30.2%) and more than 20 years (11.6%).
Position of responsibility	Yes (58.9%), No (41.4%)
Participation in teaching innovation projects	Yes (29,7%), No (70,3)
Professional family	Health (21.5%), Computer and Communications (20.8%), Administration and Management (10.1%), Image and Sound (7.1%), Sociocultural and Community Services (6.3%), Physical and Sports Activities (5.7%), Hotels and Tourism (4,5%), Food Industries (3.1%), Agriculture (2.5%), Commerce and Marketing (2.5%), Installation and Maintenance (1.8%), Electricity and Electronics (1.2%), Energy and Water (1.2%), Personal Image (1.2%), Other families (2.4%).
Training cycle	Intermediate Level (54.6%), Higher Level (45.4%)

Instrument

The interview with coordinators or heads of studies was inspired by an instrument previously developed in a study on teacher adaptation in pandemics (Authors). The instrument was adapted to the university context and to the purpose of the interview, which was to describe the main educational adaptations that teachers had made during emergency remote teaching and to analyse those educational practices that would add value to VET in future scenarios. The interview (Apéndice) consisted of six open-ended questions on: technological and pedagogical adaptation to distance teaching, the value of adaptations that remained in the

classroom and the value of the adaptations that remained in the classroom and the value of the adaptations that remained in the classroom.

The questionnaire addressed to teachers was created ad-hoc, based on the proposed classification of teaching strategies and the use of digital technologies during the pan-demographic period, collected in previous studies (Noguera and Valdivia, 20). The questionnaire addressed to teachers was created *ad-hoc*, based on the proposed classification of teaching strategies and the use of digital technologies during the pan-demic collected in previous studies (Noguera and Valdivia, 2023; Quesada et al., 2019). These classifications were reworked to generate four groups of strategies (master, situated, autonomous and active), two groups of technologies (digital teaching platform or external tools) and two modes of communication (synchronous - referring to the interaction between teachers and students at the same time - and asynchronous - referring to the interaction between teachers and students at the same time - and asynchronous - referring to the interaction between teachers and students at the same time - and asynchronous - referring to the interaction between teachers and students at the same time - and asynchronous - referring to the interaction between teachers and students at the same time.

The first section of the questionnaire collected demographic information (gender, age, positions of responsibility, participation in innovation projects, years of teaching experience, professional family and training cycles in which they taught). The first section of the questionnaire collected demographic information (gender, age, positions of responsibility, participation in innovation projects, years of teaching experience, professional family and training cycles in which they taught). The second section consisted of a selection of fifteen teaching strategies (Table 2) that were asked about: 1) their use during confinement (academic year 2019-20), alternate presence (academic year 2020-21) and current use (academic year 2021-22)[2], 2) synchronous use, 3) asynchronous use,
4) use in teaching platform and 4) use in external tools.

The two research instruments were subjected to expert validation during February and March 2022 on the basis of the univocity, relevance and importance of the items (Zambrano, 2017). Seven judges (five women and two men), experts in qualitative research, VET -including three VET teachers-, educational technology and teaching methodologies, carried out the validation process. After the validation of the instruments, relevant improvements were made. These instruments, as well as the research design, were also validated by the ethics committee of the Universitat Autònoma de Barcelona.

Data collection and analysis procedure

The individual semi-structured interviews with VET head teachers and coordinators were conducted online during March and April 2022 using the Teams videoconferencing tool.

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[2] Each moment of the pandemic involved a different mode of teaching, in order, distance learning, semi-face-to-face and face-to-face.

They were audio-recorded with the informed consent of the participants and lasted approximately 45 minutes. Each transcript was reviewed by the two researchers involved in the interview.

The questionnaire, which was anonymous, was administered online during May 2022 and teachers were given three weeks to respond. For quantitative data analysis, the IBM SPSS Statistics v.25 statistical package was used. After exploratory analyses in which the non-compliance with parametric assumptions was verified, Spearman ordinal correlations, the Mann-Whitney U and Kruskal Wallis H tests for independent samples and the Friedman and McNemar tests for related samples were applied (López-Roldán and Fachelli, 2017).

In accordance with the expert validation, the descriptive analyses were carried out on the basis of a grouping of the fifteen teaching strategies into four dimensions or categories: master class, situated learning, autonomous learning and active learning. The grouping of the resulting teaching strategies is shown in the following table and in brackets the acronym that will appear in the results tables.

Table 2

Grouping teaching strategies into categories.

Teaching strategies (dimension)	Teaching strategies (items)
Master lecture (Magistral)	Expository session of contents (Exposition of contents) Resolution of doubts (Resolution of doubts)
Situated Learning (Situated)	Analysis and discussion of real life experiences and situations (Experience analysis). Simulations of professional activity in the classroom (Simulations) Visit from external professionals (Visit from professionals) Visiting companies (Visiting companies)
Autonomous learning (Autonomous)	Freelance work (Self-employment) Individual or group follow-up (Follow-up)
Active learning (Active)	Debate and discussion (Debate and discussion) Practical exercises (Practical exercises) Inverted classroom (FC) Group work (Group work) Oral presentations by students (Presentations)

For the analysis of qualitative data, a system of emerging categories was generated (https://ddd.uab.cat/record/273122), and therefore inductive, which was subjected to an inter-judge process by three members of the research team. Two researchers coded the interviews using Atlas.ti 22 software, reaching 95% agreement. Disagreements were resolved through a process of discussion and recoding. For this study, quotes were selected from the dimensions of "Timing", "Methodological adaptation",

"Reflections" and "Value for VET". Figure 2 shows the main dimensions and categories of analysis of the study, highlighting in grey those used for this article.
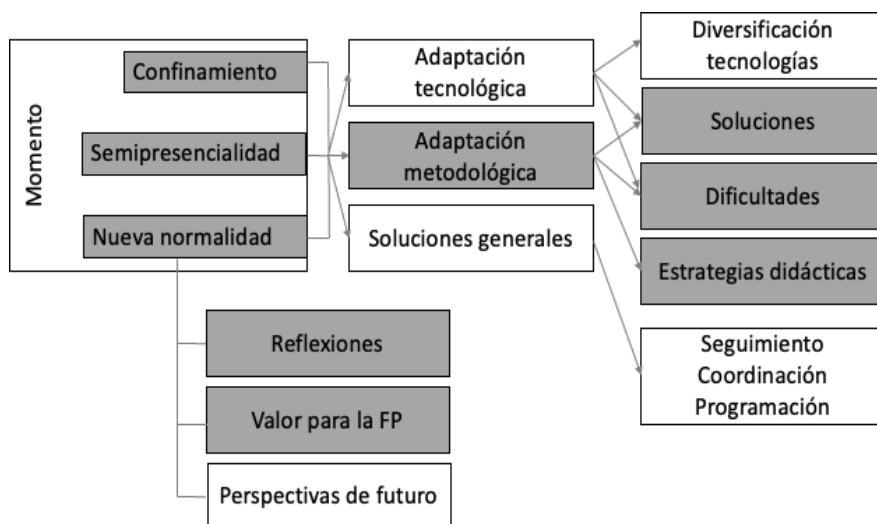
Figure 2. Category system.

Results

The non-parametric Mann-Whitney U test was applied to determine differences in the use of teaching strategies according to profile (gender, age and participation in innovation projects). Significant differences were found between teachers (n = 76, mean range = 65.15) and female teachers (n = 66, mean range = 78.77) only in the use of active teaching strategies, with female teachers being the ones who use this methodology the most (U = 2028.5, p = 0.046). On the other hand, the analyses show a low but significant relationship between the use of active strategies and teachers' age (rho = -.221, p = .008). The inverse correlation indicates that with increasing teacher age, the use of active strategies decreases. Significant differences were found in the use of active (U = 1646.5, p = ,018) and situated strategies (U = 1698, p = ,019); teachers who have participated in innovation projects use a greater variety of active (mean rank = 84.27 vs. 67.15) and situated strategies (mean rank = 84.08 vs. 66.63).

In the interviews, reflections were given on the widespread innovation process resulting from the pandemic. Some participants emphasised that age was not a determining factor, but rather the attitude towards innovation: "When we talk about

different ages of teachers, they are not only ages, but also ways of doing things. [In other words, being attentive to what is around, to the innovation that someone else has done, that is very positive". (E9).

Table 3 shows the frequency with which teachers implemented teaching strategies before and after the pandemic. The strategies most frequently used during the confinement were autonomous work, the resolution of doubts, the expository session of contents, individual or group follow-up and practical exercises. At

In the period of alternate presence (2020-21), the analysis of experiences, debate and discussion were added to the most used teaching strategies mentioned above. Those that were less used experienced a considerable increase, especially situated and active learning. At present, there is a growing trend in the use of all teaching strategies, with those related to active learning and autonomous learning standing out.

Table 3

Frequency and percentage of use of teaching strategies.

Teaching strategies (grouped)	Teaching strategies	Confinement	Alternate attendance	At present	Never
Magistral	Exhibition contents	87 (59,2%)	95 (64,6%)	106 (72,1%)	3 (2%)
	Resolution of doubts	93 (63,3%)	99(67,3%)	117 (74,6%)	1 (0,7%)
Located	Experience analysis	47 (32%)	70 (47,6%)	89 (60,5%)	15 (10,2%)
	Simulations	26 (17,7%)	56 (38,1%)	77 (52,4%)	24 (16,3%)
	Visit of professionals	15 (10,2%)	42 (28,6%)	75 (51%)	30 (20,4%)
	Company visits	5 (3,4%)	30 (20,9%)	63 (42,9%)	41 (27,9%)
Self-employed	Self-employment	93 (63,3%)	93 (63,3%)	110 (74,8%)	1 (0,7%)
	Segui miento	80 (54,4%)	90 (61,2%)	107 (72,8%)	1 (0,7%)
Active	Debate and discussion	44 (29,9%)	75 (51%)	91 (61,9%)	13 (8,8%)
	Practical exercises	84 (57,1%)	102 (69,4%)	117 (79,6%)	1 (0,7%)
	FC	25 (17%)	38 (25,9%)	44 (29,9%)	51 (34,7%)
	ABR	32 (21,8%)	55 (37,4%)	72 (49%)	29 (19,7%)
	Troubleshooting	75 (51%)	84 (57,1%)	99 (67,3%)	8 (5,4%)
	Group work	64 (43,5%)	91 (61,9%)	114 (77,6%)	3 (2%)
	Presentations	56 (38,1%)	76 (51,7%)	101 (68,7%)	10 (6,8%)

Figure 3 shows a trend towards greater diversity of teaching strategies after confinement, with a progressive increase in the use of all of them. The smallest increase has been in lecture strategies, while active learning teaching strategies have been the most used at all times.
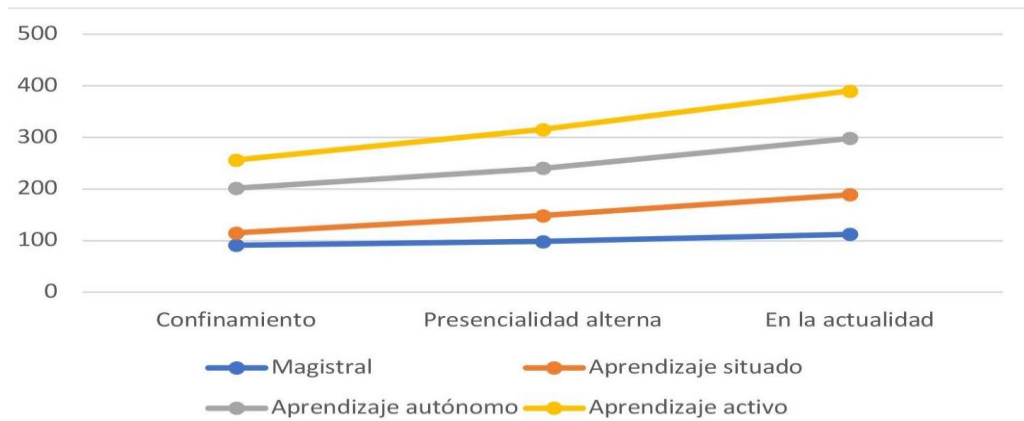

Figure 3. Use of teaching strategies by time slot.

The qualitative data confirm the reduction of mastery and the increase of active and autonomous strategies. The expository session is cited on one occasion compared to 45 citations of active strategies (Figure 4).
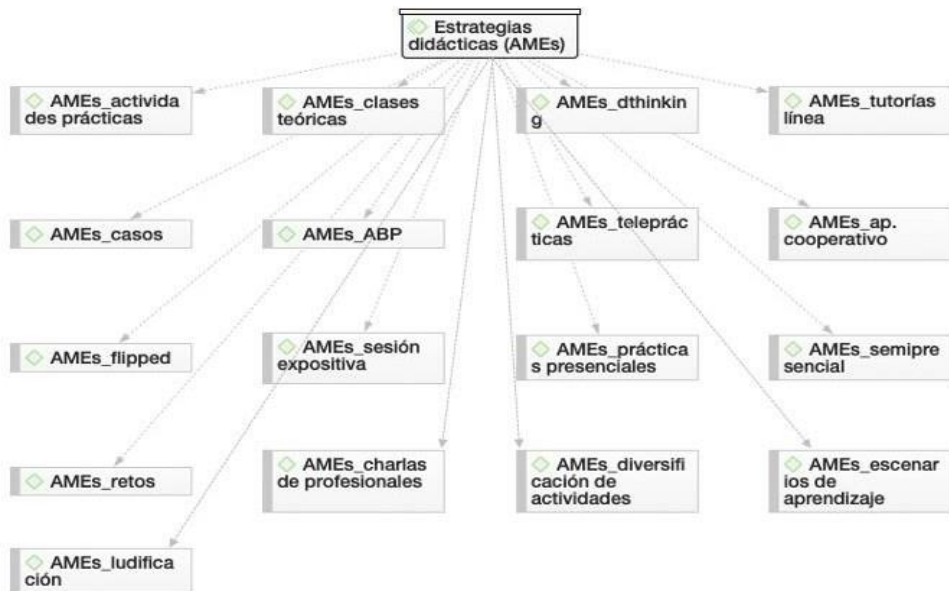
Figure 4. Subcategories identified in the dimension "Teaching strategies".

By way of example, interviewees indicated:

- "If the master class still existed in VET, it has disappeared" (E9).
- "Tending to learn, to work on projects, for students to be a bit more autonomous" (E10).
- "The *flipped* classes, that they see at home first before coming. This is something we have maintained and promoted [...] the time spent in the classroom with them is more operative, because you are going to resolve the doubts they have, so it allows you to go a little further with the students" (E3).
- "In terms of educational innovation, we have done a lot of work on project-based learning, challenge-based learning, case-based learning, collaborative learning, problem-based learning, *flipped classroom*" (E7).

In reference to the frequency of use of digital technologies for teaching (institutional platform and external tools), the synchronous use (referring to interaction between teaching staff and students at the same time) and/or asynchronous use (referring to interaction in a different space and at different times) of the different teaching strategies was analysed. The teaching modality (distance, blended or face-to-face) is represented by the time of the pandemic (in order, confinement, alternating face-to-face and topicality). Table 4 shows that the lecture strategy and independent work were the most used synchronous teaching strategies during the confinement and alternating presence (when the strategies of situated and active learning increased). At present, there is a considerable increase in the synchronous use of all the teaching strategies, highlighting the increase in situated learning strategies (+30 points) from confinement to the present. A similar result is observed in the use of active learning strategies, especially in strategies such as problem solving and group work, which double their presence, going from between 25% and 30% of use to 50% and 64% respectively. The use of autonomous work strategies increases from the confinement until today, but only slightly, which allows us to speak of a certain consolidation.

With regard to the asynchronous use of strategies, in the confinement period, the most frequently used strategies were practical exercises, the lecture strategy and autonomous learning. In the period of alternate presence, a decrease in asynchrony was observed for the expository session of contents, and an increase for the rest of the active, situated and autonomous teaching strategies. This trend is now consolidated; asynchronous use has been maintained for all teaching strategies, including lectures. In some cases, it has increased by about 10 points (e.g. debate and discussion, challenge-based learning, individualised monitoring).

Table 4

Frequency and percentage of use of teaching strategies used synchronously (S) and asynchronously (A) at different times of the pandemic.

Teaching strategies (grouped)	Teaching strategies	Confinement	Alternate attendance	At present	Never
Magistral	Exhibition contents	S: 62 (39,2%) A: 57 (36,1%)	S: 83 (52,5%) A: 47 (29,7%)	S: 96 (60,8%) A: 49 (69%)	S: 4 (2,5%) A: 13 (8,2%)
	Resolution of doubts	S: 72 (45,6%) A: 59 (37%)	S: 80 (50,6%) A: 60 (38%)	S: 94 (59,5%) A: 62 (39,2%)	S: 0 (0%) A: 5 (3,2%)
Located	Experience analysis	S: 39 (24,7%) A: 27 (17,1%)	S: 60 (38%) A: 32 (20,3%)	S: 76 (48,1%) A: 35 (22,2%)	S: 10 (6,3%) A: 29 (18,4%)
	Simulations	S: 18 (11,4%) A: 20 (12,7%)	S: 48 (30,4%) A: 25 (15,8%)	S: 70 (44,3%) A: 31 (19,6%)	S: 16 (10,1%) A: 33(20,9%)
	Visit of professionals	S: 8 (5,1%) A: 7 (4,4%)	S: 29 (18,4%) A: 16 (10,1%)	S: 57 (36,1%) A: 18 (11,4%)	S: 30 (19%) A: 46 (29,1%)
	Company visits	S: 5 (3,2%) A: 2 (1,3%)	S: 17 (10,8%) A: 13 (8,2%)	S: 48 (30,4%) A: 16 (10,1%)	S: 33 (20,9%) A: 51 (32,3%)
Self-employed	Self-employment	S: 67(42,4%) A: 58 (63,3%)	S: 72 (45,6%) A: 60 (38%)	S: 91 (57,6%) A: 63 (39,9%)	S: 2 (1,3%) A: 7 (4,4%)
	Follow-up	S: 62 (39,2%) A: 44 (27,8%)	S: 75 (47,5) A: 50 (31,6%)	S: 88 (55,7%) A: 53 (33,5%)	S: 1 (0,6%) A: 12 (7,6%)
Active	Debate and discussion	S: 38 (24,1%) A: 20 (12,7%)	S:85 (53,8%) A: 68 (43%)	S: 98 (62%) A: 67 (42,4%)	S: 1 (0,6) A: 4 (2,5%)
	Practical exercises	S: 67 (42,4%) A: 67 (40,5%)	S: 27 (17,1%) A: 22 (13,9%)	S: 33 (20,9%) A: 20 (12,7%)	S: 43 (27,2%) A: 44 (27,8%)
	FC	S: 10 (6,3%) A: 31 (33,5%)	S: 44 (27,8%) A: 40 (25,3%)	S: 61 (38,6%) A: 40 (25,3%)	S: 22 (13,9%) A: 25 (15,8%)
	ABR	S: 66 (41,8%) A: 53 (33,5%)	S: 74 (46,8%) A: 58 (36,7%)	S: 92 (58,2%) A: 58 (36,7%)	S: 7 (4,4%) A: 11 (7%)
	Problem solving	S: 48 (30,4%) A: 46 (29,1%)	S: 53 (36,8%) A: 52 (32,9%)	S: 92 (63,9%) A: 53 (33,5%)	S:1 (0,6%) A: 11 (7%)
	Group work	S: 39 (24,7%) A: 27 (17,1%)	S:63 (39,9%) A: 34 (21,5%)	S: 80 (50,6%) A: 31 (19,6%)	S:8 (5,1%) A: 25 (19%)
	Presentations	S: 38 (24,1%) A: 20 (12,7%)	S:85 (53,8%) A: 68 (43%)	S: 98 (62%) A: 67 (42,4%)	S: 1 (0,6) A: 4 (2,5%)

At present (graph 5), the results show that teachers make greater synchronous use of all strategies. The asynchronous use of lectures and active learning strategies stands out, with over 50% being asynchronous.
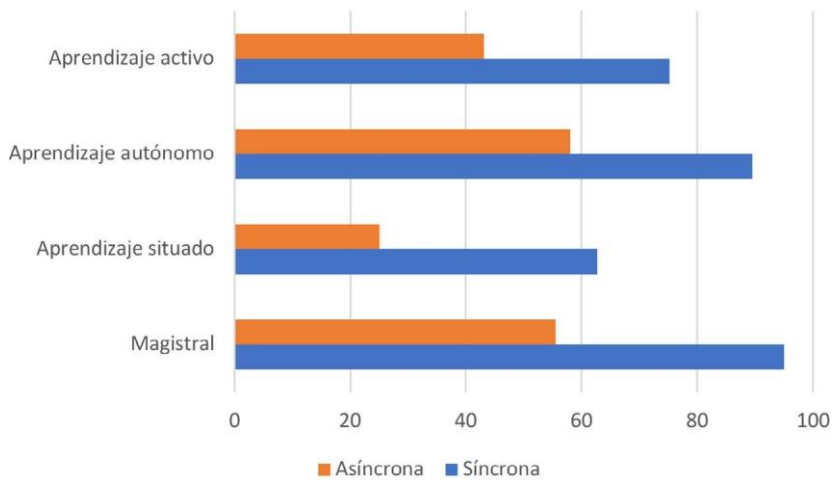
Figure 5. Synchronous and asynchronous use by teaching strategies.

However, if we consider the proportion of teachers using each strategy synchronously and asynchronously, we see that there are significant differences. Contingency tables were inspected for each of the strategies (synchronous and asynchronous use) and McNemar's test was applied. In all cases, the *p-value* was < .001 and for all strategies the same pattern was found: exclusive asynchronous use is almost null; all teachers who use the strategies asynchronously also use the same strategy synchronously. On the other hand, there are teachers who only use one strategy synchronously: from 11.11% who use the flipped classroom only synchronously to 35.42% who use the oral presentations synchronously.

In the qualitative study, the results found on synchronous/asynchronous use during and after the pandemic indicate the difficulties initially encountered in using active distance strategies. Problems in adapting practical (5)[3] and group activities (5), internships (7), as well as in dealing with online students (5) and time management (5) are highlighted (Figure 6). The main reasons for difficulties in active distance learning were work overload (6) and home situation (7) (Figure 7). For example: "What we have always done more in class, a role play, a discussion, a work, a small group... This was lost, or we didn't know how to find the tools". (E1). Although the interviewees highlighted the practical nature of VET and the tendency towards the inverted classroom modality, where asynchronous consultation of content is carried out and synchronous interaction and practical learning is promoted in person, the interviewees also highlighted the practical nature of VET and the tendency towards the inverted classroom modality where asynchronous consultation of content is carried out and synchronous interaction and practical learning is promoted in person. By way of example: "The inverted classroom has also remained [...] there are things that are not explained in class, the video is hung with a form, and in class we go directly to resolve doubts and do the practical work" (E4).

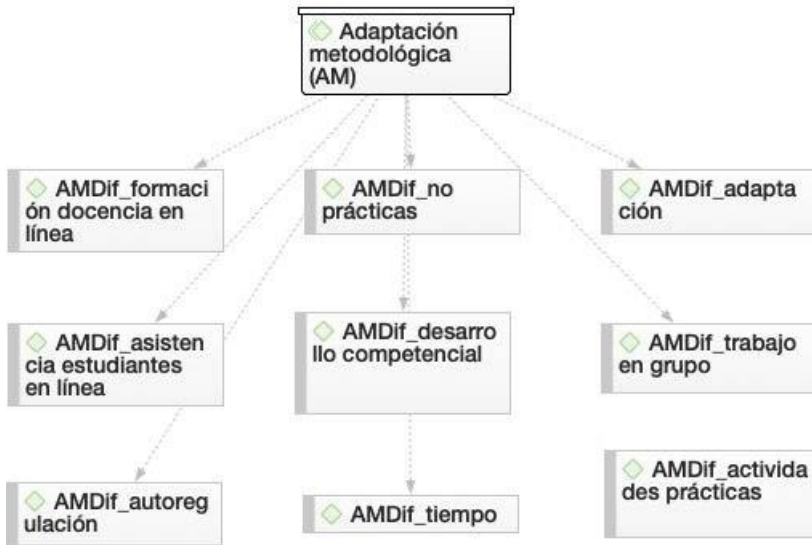[3] From this point on, the number of citations per subcategory is indicated in brackets.

Figure 6. Subcategories identified in the "Difficulties" categories of the "Methodological adaptation" dimension.
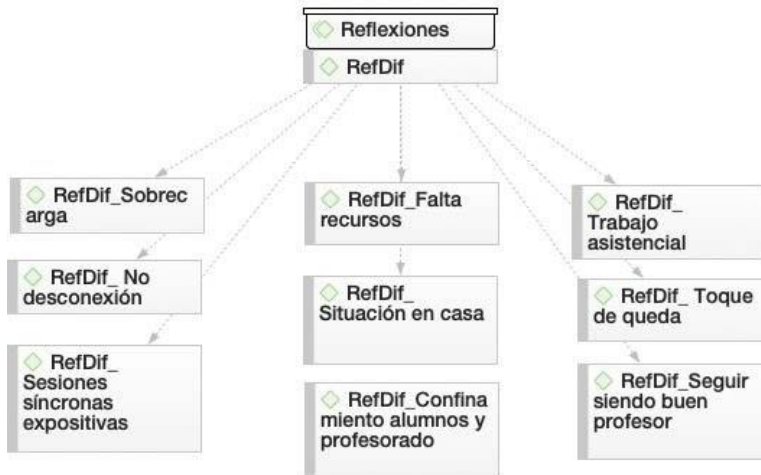

Figure 7. Subcategories identified in the "Difficulties" categories of the "Reflections" dimension.

Table 5 shows the use of strategies from the technological point of view. There is a slight increase in the variety of teaching strategies used in the institutional teaching platform, which allows us to speak of a consolidation in its use. At the same time, there is an increase in the frequency of use of external digital tools and for a greater variety of teaching strategies. The Friedman test was used to determine the significant relationship between the use of the institutional teaching platform and external tools at different times during the pandemic. The use of the teaching platform has remained unchanged (p <.056), while the use of external tools has increased at the present time (p <.017).

Table 5

Frequency and percentage of use of the institutional teaching platform (P) and external tools (H) at different points in the pandemic.

| Teaching strategies (grouped)	Teaching strategies	Confinement	Alternate attendance	At present	Never
Magistral	Exhibition contents	P: 62 (32,6%) H: 41 (21,6%)	P: 60 (31,6%) H: 44 (23,2%)	P: 57 (30%) H: 46 (24,2%)	P: 13 (6,8%) H: 21 (11,1%)
	Resolution of doubts	P: 56 (29,5%) H: 35 (18,4%)	P: 56 (29,5%) H: 36 (18,9%)	P: 55 (28,9%) H: 41 (21,6%)	P: 9 (4,7%) H: 24 (12,6%)
Located	Experience analysis	P: 28 (14,7%) H: 23 (12,1%)	P: 34 (17,9%) H: 28 (14,7%)	P: 29 (15,3%) H: 35 (17,4%)	P: 28 (14,1%) H: 29 (15,3%)
	Simulations	P: 21 (11,1%) H: 15 (7,9%)	P: 28 (14,7%) H: 28 (14,7%)	P: 24 (13,2%) H: 33 (17,4%)	P: 32 (16,8%) H: 34 (17,9%)
Self-employed	Self-employment	P: 53 (27,9%) H: 30 (15,8%)	P: 56 (29,5%) H: 35 (18,4%)	P: 57 (30%) H: 38 (20%)	P: 12 (6,3%) H: 29 (15,3%)
	Follow-up	P: 53 (27,9%) H: 29 (15,3%)	P: 54 (28,4%) H: 30 (15,8%)	P: 55 (28,9%) H: 32 (16,8%)	P: 11 (5,8%) H: 35 (18,4%)
Active	Debate and discussion	P: 26 (13,7%) H: 16 (8,4%)	P: 26 (13,7%) H: 24 (12,6%)	P: 22 (11,6%) H: 26 (13,7%)	P: 35 (18,4%) H: 36 (18,9%)
	Practical exercises	P: 63 (33,2%) H: 44 (23,2%)	P: 67 (35,3%) H: 44 (23,2%)	P: 72 (37,9%) H: 54 (28,4%)	P: 7 (3,7%) H: 18 (9,5%)
	FC	P: 17 (8,9%) H: 15 (7,9%)	P: 23 (12,1%) H: 23 (12,1%)	P: 21 (11,1%) H: 20 (10,5%)	P: 40 (21,1%) H: 46 (24,2%)
	ABR	P: 30 (15,8%) H: 22 (11,6%)	P: 43 (22,6%) H: 31 (16,3%)	P: 44 (23,2%) H: 33 (17,4%)	P: 26 (13,7%) H: 32 (16,8%)
	Problem solving	P: 54 (28,4%) H: 43 (22,6%)	P: 55 (28,9%) H: 43 (22,6%)	P: 57 (30%) H: 48 (25,3%)	P: 13 (6,8%) H: 21 (11,1%)
	Group work	P: 39 (20,5%) H: 32 (16,8%)	P: 54 (28,4%) H: 31 (16,3%)	P: 54 (28,4%) H: 37 (19,5%)	P: 17 (8,9%) H: 27 (14,2%)
	Presentations	P: 27 (14,2%) H:24 (12,6%)	P: 36 (18,9%) H: 30 (15,8%)	P: 30 (15,8%) H: 32 (16,8%)	P: 26 (13,7%) H: 28 (14,7%)
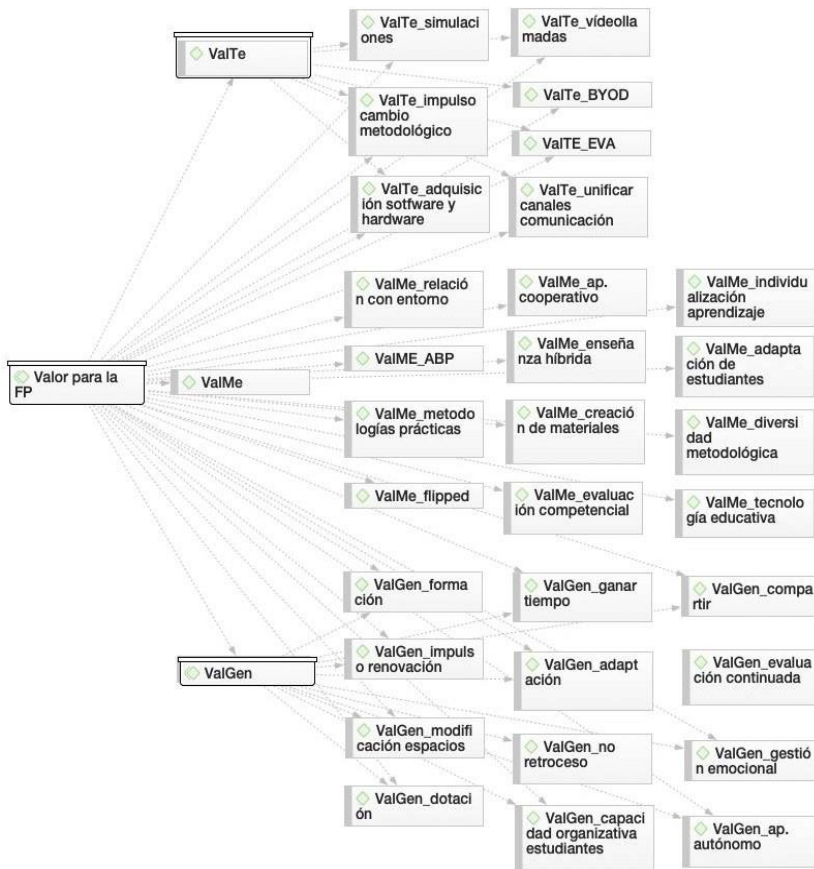
Figure 8. Subcategories identified in the "Technological Value", "Methodological Value" and "General Value" categories of the "Value for VET" dimension.

The data collected in the interviews also reveal the widespread increase in the use of digital technologies and its continuation after the pandemic. In confinement, the digital platform and external tools were used. During blended learning, there was greater centralisation in favour of the teaching platform. Technologically, the value added to teaching by the use of video calls, the widespread use of the teaching platform as a communication channel (as opposed to the pre-pandemic use as a repository), the technological equipment and the boost that all this has given in pedagogical terms (see Figure 8 "ValTe" dimension). Methodologically, Project Based Learning (PBL) (16), competency-based assessment (8) and the flipped classroom (5) are the most frequently cited elements (see Figure 8 "ValMe" dimension). There is a general feeling that the pandemic has driven a technological and methodological change (11) that was already underway, that it has promoted digital competence training (7) and that it has fostered adaptability (7). There is a feeling

The general view is that technological incorporation will remain (see Figure 8 "ValGen" dimension). As an example:

- "The [Google] *Classrooms* and *Moodles* set up for all subjects, a high percentage of them are being used, the recordings, the quizzes, they are being used, the specific *app* tools." (E7)
- "It has made us have to train ourselves minimally or do some research. But research to see that beyond the classroom, there are other methodologies, other platforms that can enrich our learning in the classroom. (E8)
- "This [use of technologies] was born in a pandemic, but it will not die with it, that is, it will continue, because we have seen that it is a good resource, and, therefore, we continue to work in this line." (E3)
- "Nowadays nobody thinks that without new technologies or without a platform or without these activities we cannot function [...] that the presence can be physical and online. So it requires this double platform or use of tools" (E1).

Discussion

European sources call for promoting innovation in VET (European Commission, 2020), which contrasts with teachers' positive perception of their innovative attitude (80% affirmative response in TALIS 2018) (OECD, 2019). It is revealing that, in this study, women, younger teachers and those who have participated in innovation projects are those who use more active teaching methodologies. It is surprising that, with the percentage of teachers up to 39 years of age being only 20.5% for the academic year 2020-2021 (Ministry of Education and Vocational Training, 2021), they are the ones driving pedagogical innovation. And in terms of gender, with women accounting for 47% of technical VET teachers for the same academic year (Caixabank Dualiza, 2023), their role in driving innovation is noteworthy. Finally, it is clear that those who participate in innovation projects may have a greater predisposition to change and are more able to adapt during the pandemic than teachers who are less accustomed to innovation.

With regard to teaching strategies, it is interesting that all teaching strategies have increased in use throughout the pandemic, especially active and autonomous learning strategies. These data contrast with the pre-pandemic results of the 2018 TALIS teacher survey (OECD, 2019) which shows that strategies related to cognitive activation, which could be linked to an active learning approach, are used by teachers at a rate of approximately 45%. The post-pandemic literature has shown that there is a trend towards active learning (ILO, World Bank, UNESCO, 2021). Furthermore, it is noteworthy that, while the pre-pandemic literature places the master class as the predominant strategy (Amaechi and Chinujinim, 2016; Schaap et al., 2017), this study shows that the diversity of teaching strategies implemented by Catalan teachers has increased as a result of the pandemic. According to Cedefop (2022), it seems that the pandemic has contributed to the already initiated renewal of teaching strategies.

pedagogy. The results of this research corroborate the need to strengthen situated learning expressed by the European Commission (2020).

The data also shed light on the frequency of use of digital technologies, distinguishing between the teaching platform and external tools and synchronous and asynchronous use of these. It is not surprising that all strategies are used more synchronously, since the return to face-to-face teaching has prioritised synchronous teaching. However, it is observed that the asynchronous use of all the strategies has increased after confinement, especially (in order of frequency) those of autonomous, active and situated learning. As shown in the qualitative data, asynchronous time is time spent outside the classroom for autonomous learning and consulting resources, while synchronous time is used for practical exercises, resolving doubts and group work, which could indicate a trend towards an inverted classroom model as indicated in the study by Magetos et al. (2022). On the other hand, a remarkable result is that all teachers who use strategies asynchronously also use them synchronously. It could be interpreted that teachers who are concerned with pedagogical design take into account the different learning spaces of their students. This contrasts with Hoffman (2021) who states that a set of VET teachers used synchronous tools during the pandemic while Hippe et al. (2021) consider that the use of asynchronous tools is yet to be exploited.

With regard to the use of technologies, it is remarkable that there is an increase in the variety of teaching strategies used both on the institutional platform and in external tools. It could be assumed, as the interviewees indicated and as has been highlighted in the literature, that prior to the pandemic the use of the teaching platform was as a repository (Mirete et al., 2020). However, the pandemic seems to have favoured the use of the teaching platform as a Virtual Learning Environment, where, apart from consulting content, activities are also carried out and communicative exchanges take place. On the other hand, the data show that, after the pandemic, the use of external tools has increased. According to Adedoyin and Soykan (2020), it could be interpreted that teaching platforms do not meet all teachers' needs and that teachers are therefore looking for external tools. On the other hand, we interpret that teachers look for the most appropriate resources for teaching. In line with Casal et al. (2022) and Suárez-Guerrero et al. (2021), the results of this study seem to confirm the advances in teachers' digital competence.

Conclusions

The results of this study are novel because they analyse the use of technologies from a pedagogical approach, and not merely instrumental, and from the field of VET where there is little literature on teaching strategies and digitisation (Casal et al., 2022). In line with the results of the OECD (2021), in the context of Catalonia, the pandemic seems to have contributed to a digital and methodological transformation that had been trying to be activated for years. On the one hand, the VET teachers surveyed use a greater variety of teaching strategies. On the other hand, although, according to Nogueres (2021), face-to-face teaching is indispensable, the

The technological advances achieved are being maintained and it is foreseen that in the near future VET will be more flexible, digital and blended learning.

The results obtained reinforce the evidence that VET teachers in Catalonia have evolved technologically and methodologically and that they maintain an innovative attitude. In the post-COVID era, in which society is more digitalised and accustomed to change, this evidence implies the need to maintain the progress achieved, establishing clear educational and school policies to: (a) train teachers in digital competence and active learning strategies, (b) establish spaces for resource sharing among teachers, enhance the use of teaching platforms and collaborative tools, (c) promote, consolidate and recognise methodological innovation, (d) foster the relationship with business and dual training programmes, (e) promote flexibility in curricula, allowing students to choose between different training itineraries and modules, and (f) work together with the educational administration to explore teaching modalities mediated by digital technologies.

With regard to the limitations of the study, it is important to highlight that, as we are working with a purposive sample, the results obtained cannot be generalised to the entire population of VET centres in Catalonia, which conditions their interpretation and the scope of the study. It is suggested that future research should be carried out with representative samples at national level in order to obtain a more complete picture of the situation of VET modernisation in the country. Furthermore, it would be interesting to carry out a study analysing the discourse of the people interviewed in depth, with the aim of generating grounded theory on the perceptions and attitudes of these actors in the VET modernisation process. It is proposed to continue researching the impact of VET teachers' digital competence on the use of innovative teaching strategies and the use of digital tools. It would also be of great interest to conduct a cross-sectoral study on dual VET, focusing on the collaboration between VET institutions and companies, with the aim of preparing apprentices for the digital evolution of the labour market.

Funding

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Appendix

Interview instrument

This interview is carried out in the framework of a research project entitled "Being VET in Spain: Trajectories of success and social value in Vocational Education and Training". The objectives we pursue with this interview are:

1) Describe the main educational adaptations that teachers have made during emergency remote teaching, and
2) Analyse those educational practices that add value to VET in future scenarios.

The pandemic era, since 2020, demanded methodological changes from all teachers. At first, remote teaching had to be provided, then discontinuous face-to-face or blended learning, and now we are in the so-called new normal.

The question is whether these changes have introduced any added value for face-to-face teaching in VET.

Centre:
Name and surname of the person interviewed:
Date of the interview:
Place: Interviewing
researcher: Duration of the
interview:

Moment	Dimensions	Items
Remote emergency education (year 2020)	Technological Adaptation (TA)	1. How has the school adapted the teaching of the various subjects, in technological terms, to distance or blended learning?
	Methodological Adaptation (MA)	2. In what way has the centre adapted the teaching methodology of the various subjects to distance or blended learning?
Current situation: Discontinuous face-to-face or blended learning	Value for VET (Val)	3. Which technological adaptations from the previous stage have remained because they are considered an improvement or an added value? Which ones have not and why? Can you What does this value consist of?
		4. Which methodological changes from the previous stage have remained because they are considered an improvement or an added value? Which ones have not and why? Can you specify this value? What does this value consist in?
Future	Future perspectives (FP)	5. In the future, are there any plans to incorporate more changes as a result of the experience?
		6. As a Centre, what reflections do you have for the future when comparing teaching before the pandemic and during the pandemic?