Media and Communication
2025 • Volume 13 • Article 8974
https://doi.org/10.17645/mac.8974

cogitatio

ARTICLE

Open Access Journal

A Flexible Framework Integrating Digital and Social Competences in Vocational Education Across Diverse Contexts

María José Hernández-Serrano [1], Joe Cullen [2], Barbara Jones [3], and Noelia Morales Romo [4]

[1] Department of Theory and History of Education, University of Salamanca, Spain
[2] Arcola Research, Tavistock Institute London, UK
[3] Bibliometrica, UK
[4] Department of Sociology and Communication, University of Salamanca, Spain

Correspondence: María José Hernández Serrano (mjhs@usal.es)

Submitted: 25 July 2024 **Accepted:** 24 November 2024 **Published:** 23 January 2025

Issue: This article is part of the issue "Evaluating and Enhancing Media Literacy and Digital Skills" edited by Leen d'Haenens (KU Leuven) and Willem Joris (Vrije Universiteit Brussel), fully open access at https://doi.org/10.17645/mac.i466

Abstract

Competence frameworks in general education environments have emerged to define the knowledge, skills, and attitudes that contemporary educators need to acquire. Such frameworks have been less developed within vocational education and training (VET) although this sector is directly impacted by rapid and complex technological changes increasingly embedded in industrial and organisational demands of the working context. Many VET classrooms with dual or flexible contexts, with a range of demographically and culturally diverse learners, now require teachers to be trained with new competences and cross-cutting skills to cope with the resultant wider and deeper changes in knowledge. This article presents the outcomes and data of the design and validation processes of a competence framework combining digital and social skills. It was piloted in five countries (UK, Sweden, Germany, Italy, and Spain) to provide a flexible, and needs-based competence framework for VET teachers working with vulnerable learners. After conducting a literature review and a needs assessment of VET teachers and learners, a flexible three-domain framework is presented, with pathways and training methods that account for the so-called poly-contextual skills that combine digital and social skills. The flexible framework and 26 competences were tested with 358 VET teachers using three evaluation tools (self-assessment survey, game-quiz scores, and programme satisfaction survey). Conclusions highlight the need to combine digital and social skills together with media literacy through flexible pathways to achieve better results for teaching, learning, and empowering learners.

Keywords

competence frameworks; digital skills; self assessment; soft skills; vocational education and training; vulnerable learners

1. Introduction

Vocational education and training (VET) systems have traditionally been characterised as occupation-specific (European Centre for the Development of Vocational Training, 2024), leading to the acquisition of essential job knowledge, skills, competences, and work experience to enable effective functioning in an occupation or achieve integration into the labour market. However, the landscape within which VET systems now operate, the expectations laid on VET teachers—the skills they train for—have and are undergoing rapid transformation. This is a result of advances over recent decades in technological digitalisation, robotics, and automation of many existing industrial, business, and labour processes proceeding exponentially and now with applications emerging from AI ecosystems gradually diffusing across and into all aspects of human activity (Bushwick, 2023; Hirvonen et al., 2024). New and emerging technologies are creating digital inter-dependencies that are transforming institutional and organisational arrangements and the knowledge bases on which they operate (Bailey et al., 2022). This latter point is important if we accept that rapid technology diffusion means that new and adapted skills and competencies will have to take place over and regardless of obstacles of professional, sectoral, educational, and cultural distance (Jones & Miller, 2007). It is yet unclear as to where this will all lead.

Notwithstanding that uncertainty, at the macro level, VET systems are increasingly viewed by policymakers as critical for reskilling and upskilling dynamic workforces able to respond to these rapid techno-economic and societal changes (European Centre for the Development of Vocational Training, 2020). These systems are expected to play a significant role in sustainable competitiveness, social fairness and resilience, and as enablers of recovery and transitions to digital and green economies (European Commission, 2021). These policy imperatives indicate ongoing governmental and industry concerns and even anxieties as to how to provide a wide basis of generic and digital skills and competences to cope with rapid and unforeseeable technological changes affecting general populations. Essentially then, it is important to consider the values of digital humanism that focus on people in relation to technological advances in order to face the challenges posed by the latest technological developments (Fernández-Fernández, 2021). Technology has to be used to improve the quality of life of all people, however, as Habermas and Husserl (1995) stated, the interests of knowledge condition the fact that technology is not neutral and objective. Implicit then in many policy and political statements is the underlying notion that VET must also be fundamentally concerned with the social, creativity, and whole-person development of individuals, rather than focusing only on occupational skills that facilitate entry into the labour market. It recognises intersectionality, class, race, age, gender, the workless, those in precarious employment, and unemployed youth cohorts. Certain groups are particularly vulnerable often leading to social exclusion: migrants who are the target of numerous discourses in the media (Blanco et al., 2022), women who are victims of sexism and digital violence (Malquín-Robles & Gamir-Ríos, 2023), or elderly people who suffer more directly from the digital gap (Mohan et al., 2024). VET teachers and their students are acutely exposed to rapid technological transformations. They must acquire and maintain ongoing knowledge of occupation-specific hardware and software whilst at the same time consolidating the use of digital tools into their pedagogical and didactic practices (Lahn & Berntsen, 2023). They are expected to deliver high-quality training, foster technical and digital skills, and through innovative training methods including in virtual environments in line with state-of-the-art vocational and digital pedagogic work with digital learning tools in diverse and multicultural environments (Mulyadi et al., 2019).

In coping with such demands and transformations, several teacher competences frameworks have emerged to define the knowledge, skills, and attitudes that contemporary educators should acquire from a myriad of

approaches to teacher education and professional qualification standards (see the compilation by UNESCO-UNEVOC, 2023). The specificity of VET as a diverse, labour-specialised, and empowering system now requires a set of competences for polycontextual training and boundary-crossing learning environments encompassing an understanding of class, online, work, enterprise, labour market, outreach, social responsibility, entrepreneurism, etc. (Down, 2011; Esmond, 2020; Harreveld & Singh, 2009; Sauli et al., 2021). Within this landscape, some VET-specific teacher frameworks have evolved to combine digital and professional competences: including mentoring technology-enhanced pedagogy, digital teaching professional framework, VET teachers embracing digital disruption, VET teachers and embracing the digital disruption, technical and VET teachers' digital competence model, and recently DigComp4Vet. However, the focus of these frameworks is on teachers' development of competences in using digital resources and teaching along with subject-specific, industry-specific, and employability skills, whilst competences related to learning assessment and empowering learners are less frequent, lacking in a combination of technical and non-technical skills, and omitting processes of how to embed digital citizenship in VET teaching and teacher education (Nylund et al., 2019; Rönnlund et al., 2019; Rosvall & Nylund, 2022)

Further, to the acquisition of digital and professional skills, the Osnabrück Declaration (European Commission, 2021) asserted that VET systems need to combine these challenges with those arising from climate change and the consequences of Covid-19. Cutting across all societal areas, the major global challenges of the UN Sustainable Development Goals 2030 have highlighted the need for combined and comprehensive training in both digital skills and other social, soft, or specific skills for inclusion and progression towards more equitable and sustainable societies (McGrath & Ramsarup, 2024; OECD, 2019; UNESCO, 2017). In sum, fluid technological diffusion, the commitment to societal challenges, and the constant demands from evolving labour markets are requiring VET teachers to train learners in a wide range of competences for maximum applicability, to meet VET functions of upskilling and reskilling. Critically, this is in contrast to the reality of many VET classrooms with dual or flexible contexts, with a range of diverse and often vulnerable students (Vermeire & Van den Broeck, 2024) and with teacher profiles in dealing with the digital divide and possibilities of exclusion (Nguyen, 2020). Many of these teachers' competences frameworks do not fit all solutions, neither consider the teacher's needs nor their own starting competence levels, but to offer top-down domains of teachers' professional activities, usually from a rigid progression level, and rarely from a standpoint of how to achieve flexible acquisition. The FLEXI-COMP project is a response to these many requirements aiming to deliver an innovative curriculum, applicable throughout the European VET area, for supporting the acquisition and application of digital and social competences of educators, so that they can in turn work with disadvantaged VET learners and excluded youth to improve their own social and digital inclusion. Disadvantaged learners can be defined as those faced with difficulties in adapting to the educational environment, low levels of curricular competence, difficulty in accepting the educational institution's operating rules, conflicts among peers, low self-esteem, and lack of motivation (Griffin, 2014) who experience a range of marked difficulties throughout their school career that prevent them from benefiting from the curriculum and classroom learning and barriers that are emotional, familial, or socioeconomic. Together all these factors can lead to social exclusion from access to learning environments.

2. Towards a Flexible Competence Framework

The FLEXI-COMP project's starting point was how to develop a flexible digital competence framework for VET educators. Such flexibility seeks to overcome the rigidity of generally in-use current frameworks, which

are standardized and based on linear progression, and may not be responsive to different student profiles and training needs. To this end, the project included three phases, as follows: (a) a review of the state of the art in measuring digital competences of VET educators, (b) a needs assessment pre-study on skills of 53 VET educators and 80 learners in five European countries, and (c) the design of a flexible competences framework and its piloting via a course with 358 VET educators.

2.1. Measuring Digital Competences of VET Educators: State of the Art

The state of art review indicated that progress has been made in improving teachers' digital literacy, but there are still deficits (Lahn & Berntsen, 2023; Martínez-Izaguirre et al., 2021; Villarroel & Stuardo, 2022) that need remedying to ensure that VET educators mastered the competences that will be key to their students' development. Firstly, studies found low levels of digital literacy development in relation to techno-pedagogical domains (Burns & Kanninen, 2023; Lahn & Berntsen, 2023), leading to unambitious intentions to use digital tools in the classroom. In this regard, other studies have shown that VET teachers' attitudes towards the use of technology are a determining factor for digital self-efficacy (Antonietti et al., 2022; Lahn & Berntsen, 2023; Ulfert-Blank & Schmidt, 2022), whilst others highlighted infrastructure deficits or difficulties in the ethical, legal, and safe use of technologies (Heine et al., 2023; Santi & Kustiawan, 2023). Secondly, studies found that educator age and education levels are conditioning factors in the acquisition and improvement of teaching skills, as VET teachers have lower levels of self-perceived digital teaching skills competences compared to teachers at other levels of education (Betancur & Muñoz-Repiso, 2023; Cattaneo et al., 2022), with evidence of greater time investment for older teachers coping with digitalisation (Burns & Kanninen, 2023). Thirdly, another set of studies highlights shortcomings specifically related to the volatile and complex context of VET. These studies emphasize the need for teachers to acquire competences tailored to specific needs, such as addressing the diversity and vulnerability of VET learners through care and inclusion (Atherton et al., 2019). They also stress the importance of ensuring that competency frameworks connect school and work-based learning environments (Lahn & Berntsen, 2023), adaptive to various teaching situations and roles, such as dual education (Dillenbourg et al., 2022), and provide teachers with autonomy for personalized teaching at this educational level (Lyckander, 2021; McGrath & Ramsarup, 2024).

The review showed that, although studies provide evidence of the training deficits of VET teachers, there is a limitation related to the lack of consensus on the concept of digital literacy in teaching (Skantz-Åberg et al., 2022) and to the instruments used to assess the acquisition of competences by teachers, which are based on the self-perception of knowledge or skills, but not on the actual performance of teachers (Mattar et al., 2022; Párraga et al., 2022). However, it has also been found that the use of self-perception tools does help teachers to become aware of deficiencies and training needs (Clifford et al., 2020) and that, as other studies have shown (Cattaneo et al., 2022; Lahn & Berntsen, 2023), some research with VET teachers has used instruments created or validated for other levels of education but not specifically for VET (Lahn & Berntsen, 2023; Mattar et al., 2022), with the SELFIE instrument, created for the DigCompEdu framework dominating (Munar Garau et al., 2024; Párraga et al., 2022).

2.2. VET Educators and Learners Qualitative Needs Assessment

Complementary to the literature review, the FLEXI-COMP project developed a qualitative research approach using lifeworld analysis (LWA) methodology to understand the digital experiences and needs of

VET educators, as well as those of disadvantaged learners (Patton, 1990). This method provided an understanding of how shared meanings about the digital world are constructed (Ashworth, 2003; Dahlberg et al., 2008) with "relational research" focusing on the key challenges, or "critical incidents" VET educators face working in teaching and learning situations with vulnerable learners (Finlay & Evans, 2009). These approaches aim to empirically document and understand individual lived experiences focusing on areas such as a sense of being in the world and the construction of "coping strategies."

In this qualitative pre-study, the main objectives were to understand and capture the barriers and challenges that inhibit the use of digital tools in teaching and learning. LWA aimed to capture the "lived experience" of FLEXI-COMP's target groups: VET educators and VET learners from vulnerable groups.

Regarding the sample of educators, a total of 53 VET educators participated, with six interactive focus groups involving 29 educators and 23 individual structured interviews with educators from Italy, Spain, Sweden, and the UK, without participants from Germany. The majority of participants (57%) were in the 36–50 age group, 31% were in the 51–65 age group, and 12% in the under 35 age group. No significant differences in age were identified across the participating countries. Slightly more females (53%) were represented than males. The participating cohorts showed a spread across the spectrum of VET teaching experience, from less than one year to over 30 years, and most VET educators (67%) self-reported a high or very high level of digital competences, with only 12% rating themselves low.

Regarding the experiences of using digital tools and challenges faced in everyday life by vulnerable and disadvantaged learners, data were collected through nine interactive focus groups involving 80 learners from Italy, Spain, Germany, Sweden, and the UK. All participants were in the 16–25 age group. Females were under-represented, with males constituting 73% of participants. A quarter of participants identified as belonging to a minority ethnic group, either first or second-generation. A large majority (71%) of learners self-reported a moderate or low level of digital competences, 22% rated themselves high, and 7% very high.

The data obtained from the interactive focus groups and structured interviews were analysed using a phenomenological content analysis methodology based on "reduction" (Creswell, 1998; Patton, 1990; Willig, 2001). This process entailed transcription of data recordings, bracketing and phenomenological reduction, delineating units of general meaning, delineating units of meaning relevant to the research question, independent verification, eliminating redundancies, clustering units of relevant meaning, determining themes from clusters of meaning, summarising individual interviews and focus groups, triangulation of summaries, identifying general and unique themes for all the summaries, contextualization of themes, and composite integrated summary. The approach included analysis of the themes identified set against participant profiles and settings, comparing participant roles (educator/learner), demographics (age and gender), teaching role and experience, and digital competences. Patterns identified in relation to these factors were reported in the analysis.

Results from the LWA research reinforced the main findings of the literature review. It highlighted as key challenges: VET educators' workload pressures; lack of institutional and management support for continuing professional development, particularly in the area of digital skills; uneven access to digital infrastructure, tools, IT support, and financial constraints on training—including the "opportunity costs" of participating in training. One consistent challenge identified by the participating VET educators was working with

disadvantaged learners with low and variable skills and motivation. Key digital, media, and information competence gaps highlighted for VET educators covered: understanding the functionalities of different tools and their applicability in different teaching and learning scenarios; "techno-pedagogic" skills; learning personalisation and adaptation, particularly the ability to customise learning for vulnerable learners presenting with multiple and specific needs; and applying digital tools and practices to support learners in developing their vocational life and online safety and security. The highlighted pedagogic needs for VET educators included: hybrid environments delivering "blended" training (online and face-to-face); flexible training enabling adaptation and personalisation; collaborative learning and interactivity; supporting experimentation and problem-solving, and adapting teaching to students with disabilities, specific education needs, and variable abilities.

The LWA research also confirmed that VET learners, particularly those who are disadvantaged, often have negative previous experiences of formal education and find it difficult to flourish in a conventional teaching environment. This experience has been reinforced for many disadvantaged learners by a lack of confidence in using digital tools, a sense of "digital inadequacy" and a fear of failure in engaging with the digital world. Key digital, media, and information competence gaps highlighted for VET learners covered: core digital skills; awareness of the different digital tools that are available and what they can be used for; online safety and security; and industry-oriented skills. The pedagogic needs for VET learners emphasise the need for a flexible learning environment that reduces barriers between teacher and students, increases the range of educational modalities and spaces to work in, and increases both teacher–student and student–student interactivity. The LWA research suggested that disadvantaged VET learners require a "scaffolded" pedagogy that enables adaptation to learning profiles and circumstances. It supported the development of a holistic and multi-disciplinary training programme combining technical skills, social skills, interpersonal skills, and skills specifically oriented to the needs of disadvantaged learners, including helping to prepare for integration with the labour market as, for example, the support to keep pace with ongoing developments in digital technology, VET, and industry.

2.3. FLEXI-COMP Framework Domains and Competences

Based on the results of the literature review and LWA, a competence framework was developed which sets out the digital, social, and pedagogic skills VET educators need to work effectively with learners, particularly those who are disadvantaged, in order to more deeply develop learners' digital skills. The three domains, shown in Figure 1, develop knowledge, skills, and attitudes within competences as an open set of changeable examples rather than a discrete set of immovable structural entities (Valenta et al., 2013). Competences are therefore defined as a dialectical progression of knowledge, skills, attitudes, and purposes, where broader competence areas derive from the socio-economic context and are translated into learning outcome examples.

The framework specifies three "high level" competence domains mixing digital and social skills. Domain A—the core (generic) digital competences—covers the basic digital competences VET educators would need to apply digital tools successfully in their practice. Domain B—enabling digital competences—focuses on supporting VET educators in collaborating with learners in the classroom and facilitating their acquisition and application of digital skills. Domain C—FLEXI-COMP specific competences—focuses on the need to apply digital tools to support the needs of learners in the VET sector, as well as the need to equip VET educators with the soft skills needed to work with disadvantaged people in that sector. These three domains are associated with eight

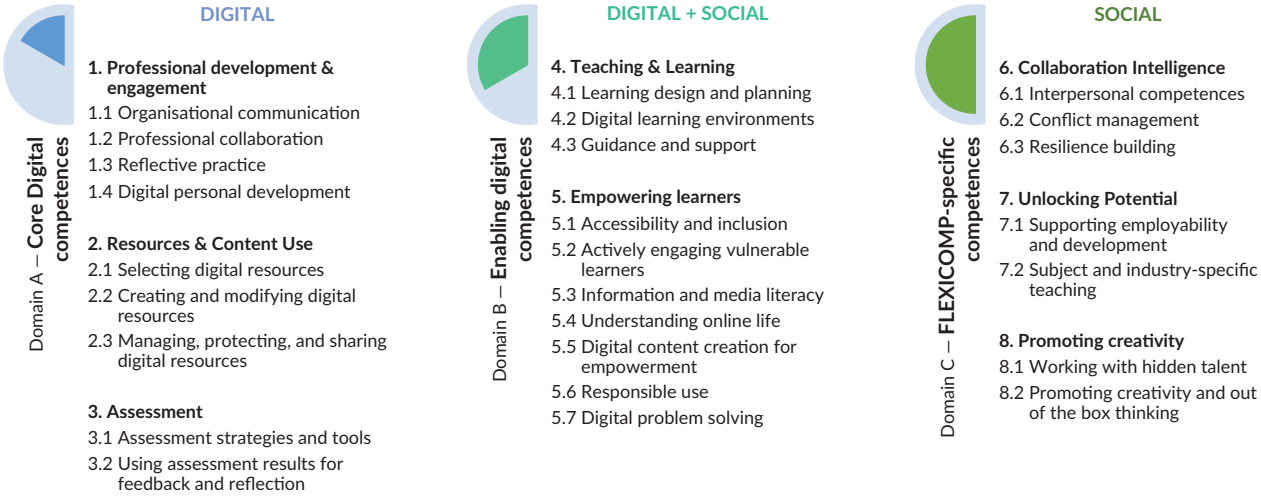

Figure 1. FLEXI-COMP's digital competences framework (see Supplementary File, Appendix 1, for a detalied explanation of domains, competences, and subcompetences).

competence areas. Each competence area covers a set of specific competences, providing 26 competences in total within the framework. Each competence describes the learning outcome associated with it.

The competence framework is the basis for the FLEXI-COMP VET training programme, an online course structured into eight "topics" corresponding to the eight competence areas in the framework. The course, delivered by Moodle, combines three types of teaching methods, which have been selected to suit the life and work style of VET educators and their professional development needs, in particular, the need to reduce the time and resources required to learn, as evidenced in the LWA phase. Teaching types are: micro-training, delivering knowledge through short video resources; podcasting, which replicates the video resources in audio format; and written text that complements the other types and covers the topic in more depth. These three types contribute to learning personalisation and flexibility because they encourage educators to customise the training course to their needs, for example by taking advantage of the resources and reference material provided in the course. Additionally, each topic starts with an interactive game (see Figure 2) which introduces the scope and "landscape" by presenting scenarios of "critical incidents" educators are likely to face in their practice, and to solve them by applying the appropriate behavioural response. The eight situational knowledge-based scenarios were produced from the LWA data and were required to be solved by applying the competences covered by the topic in actual teaching practice, posing a

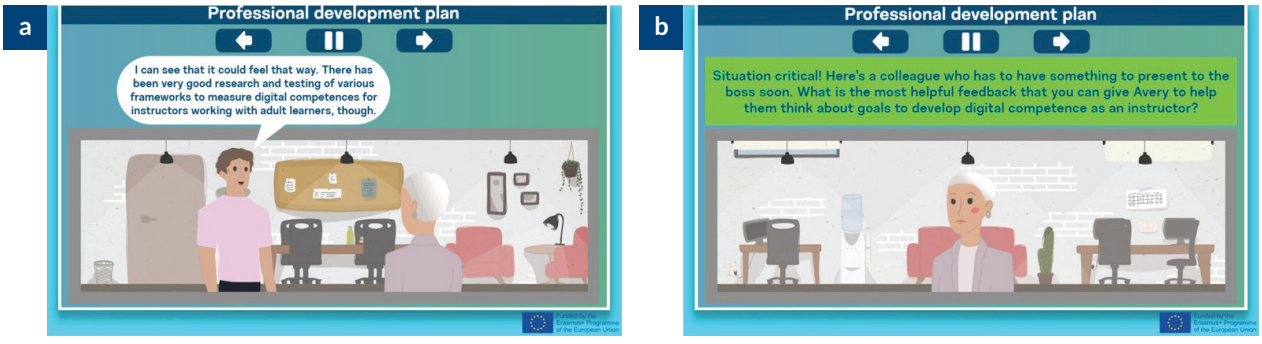

Figure 2. Example of FLEXI-COMP game scenario topic one starting (a) and ending with the critical incident (b).

challenge quiz with three responses. The game quizzes in the eight topics served an important "embedding" assessment function, helping educators to assess how much they have learned and, more importantly, to identify the gaps in their knowledge and its application.

3. Method

3.1. Procedure and Instruments

Evaluation of the competence framework and the 26 competences was "theory-driven" (Pawson & Tilley, 1997) and used change theory to assess the extent to which the programme had an effect on the "presenting problem" addressed: the low level of VET digital and social competences of educators. In other words, how the use of programme resources by participants changes their "reasoning" and how this ultimately leads to changes in behaviour, practices, and systems (Befani, 2012). To this aim, the programme piloting used three evaluation tools: self-assessment survey, game-quizzes scores, and programme satisfaction survey, described as follows.

The self-assessment survey with a "pre-test/post-test" questionnaire of training programme participants was conducted to measure their self-assessment level of competences before and after participating in the training programme; for each competence a question on knowledge and application were created, with simple examples ensuring readability and understanding with a group of piloting teachers. The survey asked teachers to rate their level of competence on a five-point scale from *very low* to *very high*. To cover immediate outcomes—changes in awareness and increased knowledge—educators were asked to rate their level with 26 questions of knowledge and 26 of application for each competence with specific examples (see Figure 3).

The game quizzes were implemented at the end of each topic. Participants were provided with a set of questions based around a "scenario challenge" that they were asked to solve using the learning derived from the training programme (see Figure 4). Selection of a particular choice option provided a reasonable consideration of a participant's competence efficacy with feedback. The game-quizzes scores were shown at the end of each module as the result of educators' self-reflection; the choice options were graded from 1 *incorrect* (0%), through 2 *partly correct* (60%), to 3 *fully correct* (100%).

The programme satisfaction survey covered two evaluation dimensions: the user experience and satisfaction with the programme content. User experience is subdivided into three evaluation criteria: meeting educator

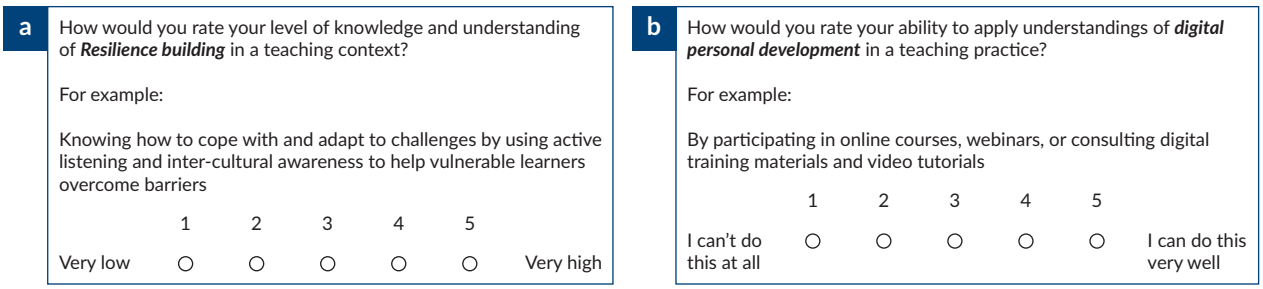

Figure 3. Examples of items for knowledge (a) and application (b) in the self-assessment survey.

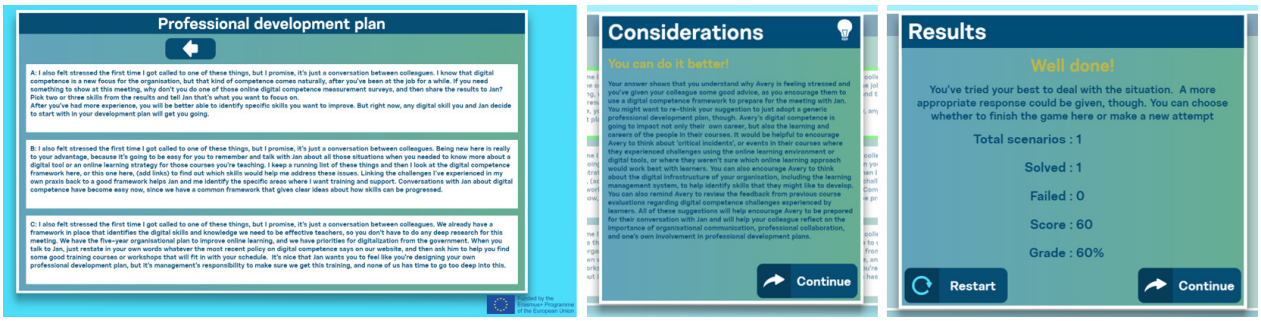

Figure 4. Example of game-quizzes items with three answers, considerations, and results with scores.

needs (coverage of training needs, ease of understanding of the programme content, relevance of the programme to continuing professional development); outcomes (measuring the degree of improvement and teaching of digital competences, application to teaching practice and usefulness); and technical usability via user-friendliness. For each indicator, survey respondents were asked to rate the programme using a Likert scale from 1 *very dissatisfied* to 5 *very satisfied*. The satisfaction with the eight modules of the training course was measured using the same scale.

The analysis of the three evaluation tools uses descriptive and comparative statistical measures (pre- and post-means t-test), without disaggregating the results by country, in order to measure the effects of the training programme from the implementation of the FLEXI-COMP competences.

The reliability of the scales used in the competence self-assessment questionnaire was assessed using Cronbach's alpha. On entry, the analysis showed an alpha co-efficient of 0.9537 for Domain A, 0.9606 for Domain B, and 0.9347 for Domain C. On exit, the analysis showed an alpha co-efficient of 0.9558 for Domain A, 0.9654 for Domain B, and 0.9401 for Domain C. This shows an excellent internal consistency across all three domains and for the questionnaire as a whole.

3.2. Sample

The competence framework and training programme were validated and pilot-tested with 358 VET educators from five countries: Germany, Italy, Spain, Sweden, and the UK. Participants were recruited to the programme through VET centres, vocational schools, higher education establishments, and community-based providers of digital training, to ensure representation across the main VET sectors. The recruitment process was designed to include a significant proportion of educators working with disadvantaged learners, those working with minority ethnic learners, migrants, not in education, employment, or training, and people with cognitive disabilities. The participants represent a broadly equal gender distribution.

During the process of piloting, of the 358 educators enrolled, 212 (60%) completed the programme. Spanish VET educators constituted the largest proportion of enrolled participants (96%), followed by Italian educators (20%), and below 20% for the UK, Sweden, and Germany. From them, 205 educators (96%) completed the pre-test self-assessment survey and 193 (91%) the post-test survey. Game quizzes were analysed from 212 educators, and the programme satisfaction survey was answered by 193 educators.

4. Results

Analysis of the self-assessment survey comparison between pre-post rates (see Figure 5) shows the change in aggregated mean educator score for the three domains of the training programme as well as the total combined competence score after completion of the training programme. The aggregate scores for each domain were calculated as a percentage of the total maximum percentage score, combining the scores for each 26 competences in each three domains, and the total score for the three domains combined. The confidence intervals for Domain A—combining knowledge and application score changes—were 18.6 and 24.2, for Domain B were 18.3 and 24.8, and for Domain C were 16.2 and 22.3 at the 95% confidence level.

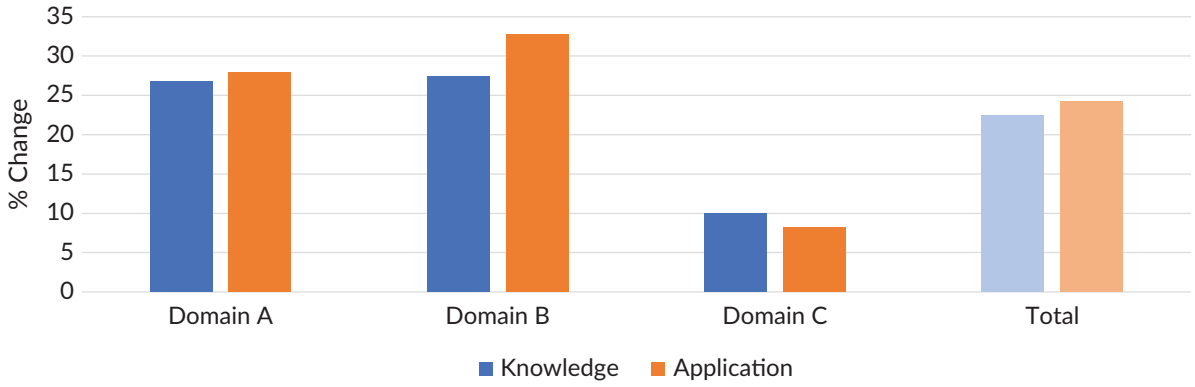

Figure 5. Change in digital competence scores comparing pre-post survey results.

Figure 5 shows that in Domain A, VET educators who completed the course increased their aggregate "knowledge" competence score by 27%, from an average of 65/100 to 82/100, and their aggregate "application" competence score by 28%, from an average of 64/100 to 82/100. In Domain B, VET educators increased their aggregate "knowledge" competence score by 27%, from an average of 64/100 to 82/100, and their aggregate "application" competence score by 33%, from an average of 61/100 to 81/100. In Domain C, VET educators increased their aggregate "knowledge" competence score by 10%, from an average of 65/100 to 71/100, and their aggregate "application" competence score by 8% from an average of 66/100 to 71/100. Overall, VET educators who completed the course increased their aggregate total "knowledge" competence score by 21%, from an average of 65/100 to 79/100, and their aggregate "application" competence score by 23% from an average of 63/100 to 79/100.

A student's t-test using a matched pair comparison of VET educators which combined domain and total competence pre- and post-survey data was run, adding together the ratings for each competence for each participant, showing that the difference in competence levels was notably statistically significant, as Table 1 shows.

Large increases in competence levels in each of the three competence domains and overall were replicated in the analysis of changes in self-rated competence levels across each of the 26 competences covered in the training programme. Generally, educators increased their competence levels across the board in all 26 competences covered by the training course, both in terms of "knowledge" and in "application," as shown in the Figures 6, 7, and 8. In Domain A (shown in Figure 6), the biggest increases in competence levels were for:

Table 1. Student's t-test, matched pair sample, educator competence scores before and after the training programme.

	Domain A	Domain B	Domain C	Combined
Mean pre-test	57.6	63.3	46.6	167.5
Mean post-test	73.6	81.5	58.1	213.2
t-Stat	15.38307982	14.16574912	13.55417287	15.55802032
P($T \leq t$) one-tail	4.25214E-31	3.2656E-28	9.69273E-27	1.65756E-31
t critical one-tail	1.656940344	1.656940344	1.656940344	1.656940344
P($T \leq t$) two-tail	8.50429E-31	6.5312E-28	1.93855E-26	3.31513E-31
t critical two-tail	1.978819535	1.978819535	1.978819535	1.978819535

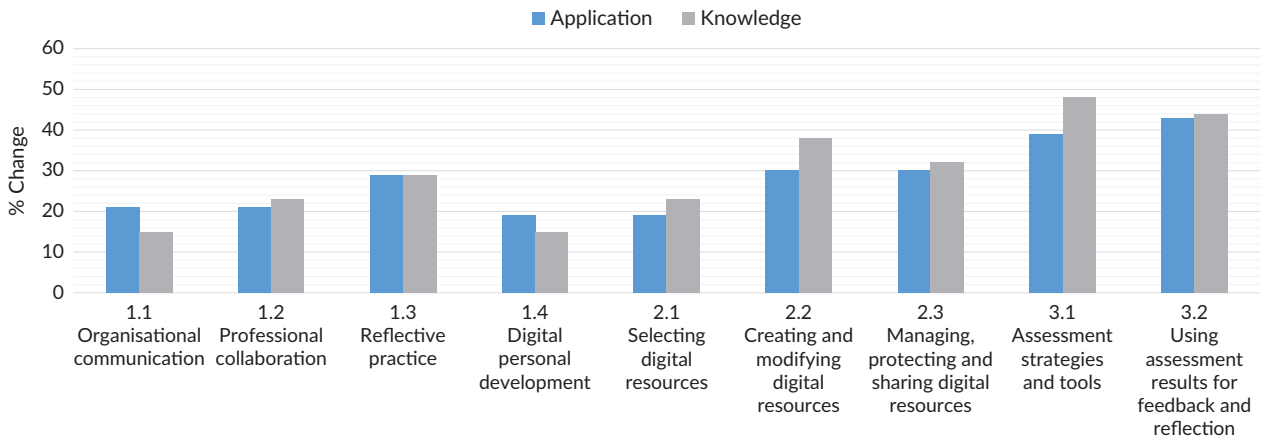

Figure 6. Changes in competence scores in Domain A—Core digital competences.

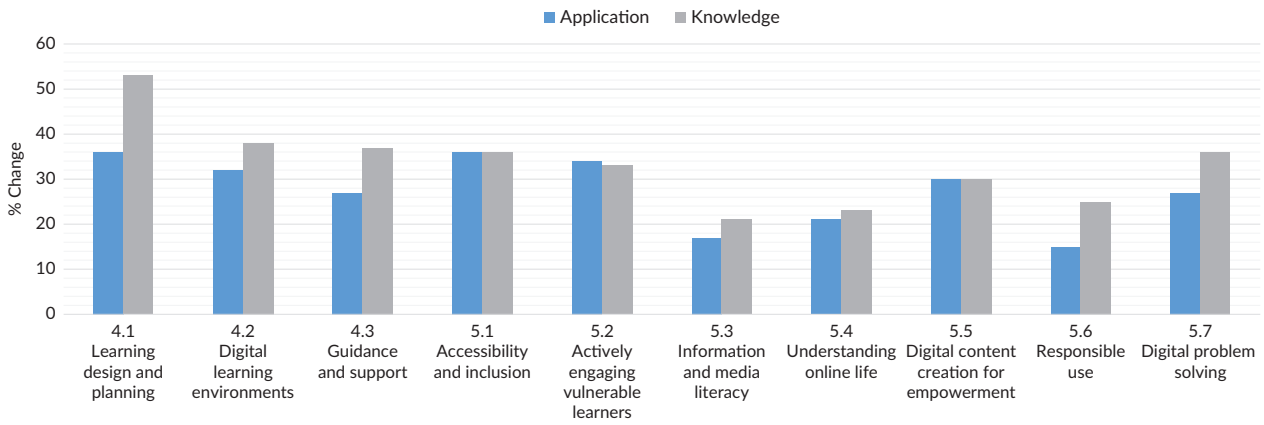

Figure 7. Changes in competence scores in Domain B—Enabling digital competences.

"assessment strategies," which increased from an average score of 2.9 to 3.9 on knowledge, and 2.8 to 3.9 on application; "using assessment results for feedback," which increased from an average score of 2.8 to 3.9 on knowledge, and 2.8 to 3.8 on application; and for "creating and modifying digital resources," which increased from an average score of 3 to 3.8 on knowledge, and 2.8 to 3.8 on application.

As Figure 7 shows, educators also increased their competence levels across the board in Domain B, both in terms of "knowledge" and "application." The biggest increases in competence levels were for: "learning design and planning," which increased from an average score of 2.9 to 4 on knowledge, and 2.9 to 3.9 on application; "accessibility and inclusion," which increased from an average score of 3.1 to 4 on both knowledge and application; and for "engaging vulnerable learners," which increased from an average score of 3 to 4.1 on knowledge, and 3.1 to 4 on application.

As Figure 8 shows, educators increased their competence levels across the board in Domain C, both in terms of "knowledge" and "application." The biggest increases in competence levels were for: "working with hidden talent," which increased from an average score of 2.9 to 4.1 on both knowledge and application; "promoting creativity," which increased from an average score of 3.1 to 4 on both knowledge and application; and for "supporting employability," which increased from an average score of 3.1 to 4.1 on knowledge, and 3.3 to 4.1 on application.

Besides the self-assessment, according to complementary measures from game quizzes, the mean grades for the educators for each of the eight programme modules were higher. These game quizzes indicated that educators who completed the training programme achieved a high level of competence, with an overall mean grade of 8.2 and no module achieving a mean grade of below 7/10. The highest mean grades were for Topic 6 Collaboration Intelligence, with a mean grade of 8.8, and Topic 2 Resource and Content Use, with a mean grade of 8.8, while the lowest for Topic 3 Assessment, and Topic 7 Unlocking Potential with mean grades of 7.3 and 7.5 respectively.

Finally, on the complementary programme satisfaction survey, Figure 9 shows how VET teachers rated the training programme on the three key user experience criteria, meeting educator needs, training outcomes and technical usability/user-friendliness, together with their satisfaction with the training programme overall, and how they rated the programme content overall.

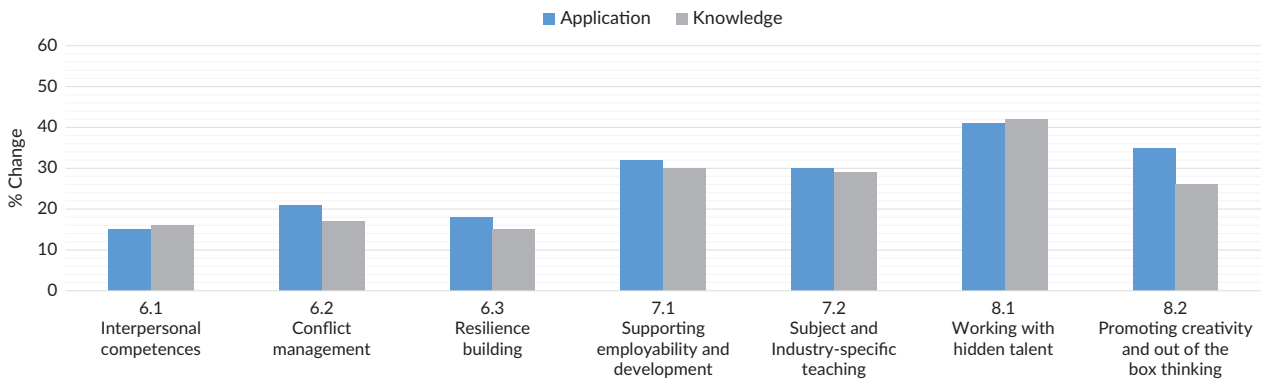

Figure 8. Changes in competence scores in Domain C—FLEXI-COMP-specific competences.

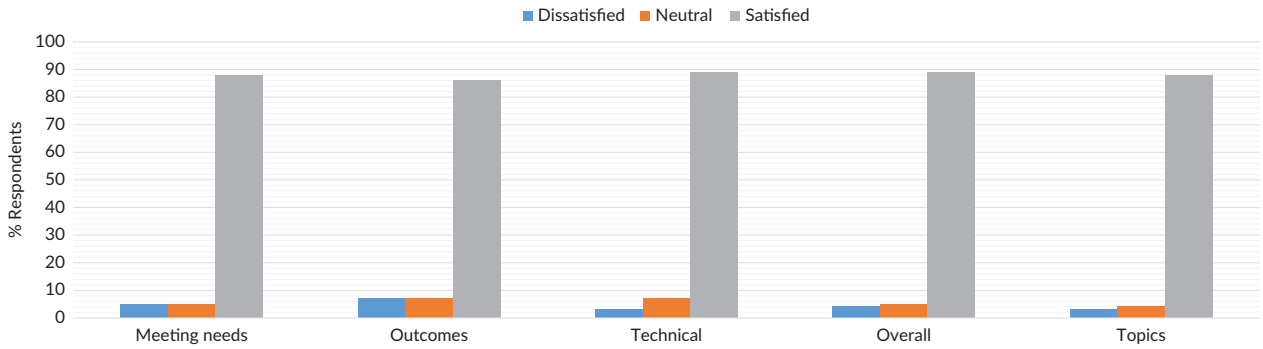

Figure 9. Training programme experience and user satisfaction.

As Figure 9 shows, on meeting needs, 88% of survey respondents said they were satisfied or very satisfied with how the training programme met their needs, with only 5% dissatisfied or very dissatisfied. In terms of outcomes, 86% of survey respondents said they were satisfied or very satisfied with how the training programme had contributed to positive outcomes for their teaching practice and professional development, with only 7% dissatisfied or very dissatisfied. Fifty-three percent of survey respondents were satisfied and 31% very satisfied with the extent to which participating in the programme had led to improved teaching outcomes and 56% were satisfied and 31% very satisfied with the extent to which the programme had contributed to improved teaching practice. With regards to the technical aspects of the programme, 89% of survey respondents were satisfied or very satisfied with only 4% dissatisfied or very dissatisfied. Evaluation of participant satisfaction with the programme content showed a high level of satisfaction overall and with the content provided in each of the eight modules—88% of survey respondents were satisfied or very satisfied with the programme content and only 4% dissatisfied or very dissatisfied.

5. Conclusions

VET clearly has an important role in tackling disadvantages across many demographic cohorts. However, the rapid and subsequent ubiquity of ICT and related new, emerging, and often unexpected technological developments are creating barriers to access and learning use for many within those cohorts, especially those unemployed and socially peripheralized, presenting problems for VET educators. Large-scale competence frameworks have been developed but most offer static tools not often appropriate in fluid and changing VET sectors. They usually rely on the one tool of self-assessment. They may even hinder the continuous achievement of disadvantaged learners who are unable to navigate an increasingly hyperconnected world where digital cross-walking is a feature of how people acquire knowledge, skills, and form attitudes. The boundaries between what is pedagogical, what is social, what is instructive, and what is aspirational are increasingly blurred. The starting point of the FLEXI-COMP project was a methodological consideration of how we begin to unpick those boundaries.

The FLEXI-COMP approach has demonstrated that the voices of VET teachers, educators, and their students are crucial in developing effective and flexible polycontextual needs-based competence teaching and learning approaches that have efficacy for VET training programmes and curricula. The LWA, listening to the voices of VET educators, clearly highlighted the difficulties faced by VET educators: workload pressures; lack of institutional and management support for continuing professional development, particularly in digital skills; uneven access to digital infrastructure and digital tools, and IT support and financial constraints on training,

including the "opportunity costs" of participating in training. The design of a competence framework with different teaching methods and game quizzes with real-context incidents is shown to address teachers' and learners' demands for flexible learning pathways that combine digital and social skills. This supports the need to develop frameworks without rigid areas or levels, but interconnected areas in combination. In this sense, FLEXI-COMP evolves from DigCompEdu (Redecker & Punie, 2017) with two more areas of social competences (collaborative interlinking and creativity) and competences for professional preparation, in line with areas of competences that are part of specific frameworks for VET, such as the digital teaching professional framework (Education & Training Foundation, 2018), the VET teachers embracing digital disruption (VET-TEDD, n.d.) and the technical and VET teacher's digital competence model (Lee et al., 2022).

The piloting results of FLEXI-COMP, and contrary to other studies with only one instrument for self-assessment, two more contrasting measures reinforce the picture. Many programme participants stated that they had gained new knowledge and ideas, learned about new digital tools and social skills, as well as how to apply these tools in their teaching practice. Learning design and planning competences were highlighted as being greatly enhanced through the FLEXI-COMP approach. The need to combine digital and social skills within flexible pathways to achieve that combination was positively evidenced in this project since the changes in knowledge and application were found for Domain B which included digital and social skills for teaching, learning, and how to empower learners.

The project also showed the need to further explore how to reinforce or develop new assessment skills and competences that can more effectively prepare students and learners for dynamic and rapidly changing labour markets. Competence frameworks for VET educators and learners should not then simply include technical skills but should deliver a holistic approach incorporating technical, methodological, social, and interpersonal skills, including social and communication skills, teamwork, and autonomy. Learning processes can be elevated within VET teacher training programs, but generalization of what methodologies and processes are used is complex due to the extensive variety of VET levels, grades, and courses and there is as yet no agreed framework for VET digital and social competences. It is clear that further research is needed, as new or reworked competences for use within VET must be developed at a pace that goes beyond the technological and methodological aspects and rooted in participatory and social dimensions.

This study can provide highlights for flexible training for VET educators for two main reasons. First because, as our literature review and LWA highlighted, VET educators engage on a daily basis with learners who present with a wide range of profiles, learning histories, and learning needs and they work in highly diverse teaching and learning environments. This requires a competence framework in which knowledge, skills and attitudes are considered within competences as open sets of changeable examples of learning outcomes rather than discrete sets of immovable structural entities (Valenta et al., 2013). Second, the demands of the job put significant limitations on continuing professional development for VET educators, which means that digital competence training needs to be adaptable and customisable.

In the area of policy recommendations and application, FLEXI-COMP has revealed several areas of relevance. First, a conduct comprehensive needs assessment to understand and locate specific digital skills gaps among VET teachers and educators. Second, developing flexible and adaptive training that covers a wide range of digital skills from basic digital literacy to advanced technology integration, combining digital with social skills. Flexibility is achieved and supported through a self-assessment tool enabling VET educators to highlight

their digital strengths and weaknesses and subsequently personalise their training accordingly. Third, a need to encourage teachers to collaborate on projects that address real challenges in their VET settings using critical incidents. The pedagogic approach adopted in the training programme supports the acquisition by VET educators of the practical skills needed to apply digital tools and techniques to suit different learner profiles and needs. And lastly, allowing the collection of feedback from both participants and facilitators to make iterative enhancements to the training framework. This is important because objective and subjective measures can be combined via self-reporting, for effective practice and acquisition of competences.

Limitations and recommendations for future studies include the use of combined and varied assessment tests and tasks for competence acquisition, along with longitudinal effects. The assessment of competence before and after the training course was implemented using a multi-method design that triangulated self-reported competence scores, user responses to quizzes in the interactive game, and a user satisfaction survey. Although this approach aimed to maximise the reliability and robustness of the evaluation results, the use of self-report measures is an obvious limitation of the study. However, the use of quiz scores in the evaluation could be seen as a compensatory "objective" measure, as they are based on the application of acquired competences rather than self-reporting. Future studies could use a combination of methods, using a performance test or the use of longitudinal scales that measure the application of acquired competences through observation of teachers or their performance tasks.

Funding

Erasmus+ European Commission: Reference: 2020–1-UK01-KA226-VET-094538. Title: FLEXI-COMP: Digital Competences for Adaptive, Flexible and Inclusive Vocational Education and Training.

Conflict of Interests

The authors declare no conflict of interests. The Ethics Committee from the University of Salamanca (Spain) approved the different phases of the design and piloting on 14/02/2022 (project 747).

Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

References

Antonietti, C., Cattaneo, A., & Amenduni, F. (2022). Can teachers' digital competence influence technology acceptance in vocational education? *Computers in Human Behavior*, *132*, Article 107266. https://doi.org/10.1016/j.chb.2022.107266

Ashworth, P. (2003). An approach to phenomenological psychology: The contingencies of the lifeworld. *Journal of Phenomenological Psychology*, *34*(2), 145–156. https://doi.org/10.1163/156916203322847119

Atherton, G., Crosling, G., Hoong, A. L., & Elson-Rogers, S. (2019). *How do digital competence frameworks address the digital divide*? UNESCO-UNEVOC.

Bailey, D., Faraj, S., Hinds, P. J., Leonardi, P. M., & Von Krogh, G. (2022). We are all theorists of technology now: A relational perspective on emerging technology and organizing. *Organization Science*, *33*(1), 1–18. https://doi.org/10.1287/orsc.2021.1562

Befani, B. (2012). Models of causality and causal inference. In E. Stern, N. Stame, J. Mayne, K. Forss, R. Davies, & B. Befani (Eds), *Broadening the range of designs and methods for impact evaluations* (DFID Working Paper 38). Department for International Development.

Betancur, V., & Muñoz-Repiso, A. G. V. (2023). Características del diseño de estrategias de microaprendizaje en escenarios educativos: Revisión sistemática. *RIED-Revista Iberoamericana de Educación a Distancia*, *26*(1), 201–222. https://doi.org/10.5944/ried.26.1.34056

Blanco, M. G., Olveira, M. E. O., & Matos, S. L. (2022). Migración, competencia digital y retos educativos. *Revista Internacional de Comunicación y Desarrollo (RICD)*, *4*(17). https://doi.org/10.15304/ricd.4.17.8756

Burns, E., & Kanninen, S. (2023). Vocational education teachers' pedagogical digital competence. *International Journal of Vocational Education and Training*, *28*(1), 37–52. https://iveta.global/wp-content/uploads/2024/01/IJVET-28.1-Layout1-December.pdf

Bushwick, S. (2023, March 16). What the new GPT-4 can do. *Scientific American*. https://www.scientificamerican.com/article/what-the-new-gpt-4-ai-can-do

Cattaneo, A. A., Antonietti, C., & Rauseo, M. (2022). How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors. *Computers & Education*, *176*, Article 104358. https://doi.org/10.1016/j.compedu.2021.104358

Clifford, I., Kluzer, S., Troia, S., Jakobsone, M., & Zandbergs, U. (2020). *DigCompSat. A self-reflection tool for the European digital framework for citizens* (No. JRC123226). Joint Research Centre.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Sage.

Dahlberg, K., Dahlberg, H., & Nystrom, M. (2008). *Reflective lifeworld research*. Sage.

Dillenbourg, P., Cattaneo, A., Gurtner, J. L., & Davis, R. L. (2022). *Educational technologies for vocational training: Experiences as digital clay*. Zenodo. https://doi.org/10.5281/zenodo.7445778

Down, C. M. (2011). The metaphor and reality of contextual transfer. *International Journal of Lifelong Education*, *30*(2), 187–212. https://doi.org/10.1080/02601370.2010.547614

Education & Training Foundation. (2018). *Digital teaching professional framework*. https://www.et-foundation.co.uk/professional-development/edtech-support/digital-skills-competency-framework

Esmond, B. (2020). Vocational teachers and workplace learning: Integrative, complementary and implicit accounts of boundary crossing. *Studies in Continuing Education*, *43*(2), 156–173. https://doi.org/10.1080/0158037X.2020.1767564

European Centre for the Development of Vocational Training. (2020). *Empowering adults through upskilling and reskilling pathways*. Publications Office of the European Union. https://www.cedefop.europa.eu/en/publications/3081

European Centre for the Development of Vocational Training. (2024). *Terminology of European education and training policy* (Cedefop reference series, no. 124). Publications Office of the European Union. http://dx.doi.org/10.2801/991753

European Commission. (2021). *Osnabruck Declaration on vocational education and training as an enabler of recovery and just transitions to digital and green economies*. Publications Office of the European Commission.

Fernández-Fernández, J. L. (2021). Hacia el humanismo digital desde un denominador común para la cíber ética y la ética de la inteligencia Artificial. *Disputatio*, *10*(17), 107–130. https://doi.org/10.5281/zenodo.5136247

Finlay, L., & Evans, K. (2009). *Relational centred qualitative research for psychotherapists and counsellors: exploring meanings and experience*. Wiley.

Griffin, T. (2014). *Disadvantaged Learners and VET to higher education transitions*. National Centre for Vocational Education Research.

Habermas, J., & Husserl, E. (1995). *Conocimiento e interés/La filosofía en la crisis de la humanidad europea*. Universitat de València.

Harreveld, B., & Singh, M. (2009). Contextualising learning at the education-training-work interface. *Education+Training*, *51*(2), 92–107. https://doi.org/10.1108/00400910910941264

Heine, S., Krepf, M., & König, J. (2023). Digital resources as an aspect of teacher professional digital competence: One term, different definitions–a systematic review. *Education and Information Technologies*, *28*(4), 3711–3738. https://doi.org/10.1007/s10639-022-11321-z

Hirvonen, N., Jylha, V., Lao, Y., & Larsson, S. (2024). Artificial intelligence in the information ecosystem: Affordances for everyday information seeking. *Journal of the Association for Information Science and Technology*, *75*(10), 1152–1165. https://doi.org/10.1002/asi.24860

Jones, B., & Miller, B. (2007). *Innovation diffusion in the new economy: The tacit dimension*. Routledge.

Lahn, L. C., & Berntsen, S. K. (2023). Frame-working vocational teachers' digital competences: An integrative literature review and synthesis. *Nordic Journal of Comparative and International Education (NJCIE)*, *7*(2). https://doi.org/10.7577/njcie.5322

Lee, A. S. H., Atherton, G., & Crosling, G. (2022). *TVET teachers for the fourth industrial age: Digital competency frameworks*. UNESCO-UNEVOC. https://unevoc.unesco.org/up/TVET_Teachers_for_the_Fourth_Industrial_Age.pdf

Lyckander, R. H. (2021). Exploring vocational teacher preparation in Norway: A study of dimensions and differences in vocational teacher learning. *Journal of Vocational Education & Training*, *76*(1), 64–86. https://doi.org/10.1080/13636820.2021.2007985

Malquín-Robles, A., & Gamir-Ríos, J. (2023). Desinformación y sexismo digital: El feminismo y su agenda como objeto de engaño en español. *Revista ICONO 14*, *Revista Científica de Comunicación y Tecnologías emergentes*, *21*(1). https://doi.org/10.7195/ri14.v21i1.1963

Martínez-Izaguirre, M., Álvarez De-Eulate, C. Y., & Villardón-Gallego, L. M. (2021). Aplicación de un análisis de importancia y realización de competencias para la identificación de prioridades en la formación docente. *Revista de Educación*, *393*, 97–128. https://doi.org/10.4438/1988-592X-RE-2021-393-487

Mattar, J., Ramos, D. K., & Lucas, M. R. (2022). DigComp-based digital competence assessment tools: Literature review and instrument analysis. *Education and Information Technologies*, *27*(8), 10843-10867. https://doi.org/10843-10867.10.1007/s10639-022-11034-3

McGrath, S., & Ramsarup, P. (2024). Towards vocational education and training and skills development for sustainable futures. *Journal of Vocational Education & Training*, *76*(2), 247–258. https://doi.org/10.1080/13636820.2024.2317574

Mohan, R., Saleem, F., Voderhobli, K., & Sheikh-Akbari, A. (2024). Ensuring sustainable digital inclusion among the elderly: A comprehensive analysis. *Sustainability*, *16*(17), 7485. https://doi.org/10.3390/su16177485

Mulyadi, Y., Sucita, T., & Purnama, W. (2019). Mapping competences of vocational teachers in the industrial era 4.0. In *5th UPI International Conference on TVET ICTVET 2028* (pp. 368–372). Atlantis Press.

Munar Garau, J., Oceja, J., & Salinas Ibáñez, J. (2024). Equivalencias entre los indicadores de la herramienta SELFIE y el marco DigCompEdu a partir de la técnica Delphi. *Pixel-Bit. Revista de Medios y Comunicación*, *69*, 131–168. https://doi.org/10.12795/pixelbit.101775

Nguyen, A. (2020). Digital inclusion: Social inclusion in the digital age. In P. Liamputtong, Ed.), *Handbook of social inclusion, research & practices in health and social care* (pp. 265–279). Springer Nature Switzerland. https://doi.org/10.1007/978-3-030-48277-0_14-1

Nylund, M., Ledman, K., Rosvall, P.-Å., & Rönnlund, M. (2019). Socialisation and citizenship preparation in vocational education: Pedagogic codes and democratic rights in VET-subjects . *British Journal of Sociology of Education*, *41*(1), 1–17. https://doi.org/10.1080/01425692.2019.1665498

OECD. (2019). *Future of education and skills 2030*. https://www.oecd.org/content/dam/oecd/en/about/projects/edu/education-2040/1-1-learning-compass/OECD_Learning_Compass_2030_Concept_Note_Series.pdf

Párraga, L. M., Llorente-Cejudo, C., & Cabero-Almenara, J. (2022). Análisis de las competencias digitales docentes desde los marcos e instrumentos de evaluación. *IJERI: Revista Internacional de Investigación e Innovación Educativa*, *18*, 62–79. https://doi.org/10.46661/ijeri.74 44

Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Sage.

Pawson, R., & Tilley, N. (1997). *Realistic evaluation*. Sage.

Redecker, C., & Punie, Y. (2017). *Digital competence of educators*. European Commission. https://doi.org/10.2760/159770

Rönnlund, M., Ledman, K., Nylund, M., & Rosvall, P. Å. (2019). Life skills for "real life": How critical thinking is contextualised across vocational programmes. *Educational Research*, *61*(3), 302–318. https://doi.org/10.1080/00131881.2019.1633942

Rosvall, P. Å., & Nylund, M. (2022). Civic education in VET: Concepts for a professional language in VET teaching and VET teacher education. *Journal of Vocational Education & Training*, *76*(3), 684–703. https://doi.org/10.1080/13636820.2022.2075436

Santi, K., & Kustiawan, I. (2023). Teacher vocational education competence in digital Age: A Bibliometric Analysis. *Journal of Vocational Education Studies*, *6*(1), 181–197. https://doi.org/10.12928/joves.v6i1.6511

Sauli, F., Wenger, M., & Berger, J. L. (2021). Supporting apprentices' integration of school-and workplace-based learning in Swiss initial vocational education and training. *Research in Post-Compulsory Education*, *26*(4), 387–409. https://doi.org/10.1080/13596748.2021.1980660

Skantz-Åberg, E., Lantz-Andersson, A., Lundin, M., & Williams, P. (2022). Teachers' professional digital competence: An overview of conceptualisations in the literature. *Cogent Education*, *9*(1), 2063224. https://doi.org/10.1080/2331186X.2022.2063224

Ulfert-Blank, A. S., & Schmidt, I. (2022). Assessing digital self-efficacy: Review and scale development. *Computers & Education*, *191*, Article 104626. https://doi.org/10.1016/j.compedu.2022.104626

UNESCO. (2017). *Education for sustainable development goals: Learning objectives*. https://doi.org/10.54675/CGBA9153

UNESCO-UNEVOC. (2023). *Digital competence frameworks for teachers, learners and citizens*. https://unevoc.unesco.org/home/Digital+Competence+Frameworks

Valenta, L., Pérez-García, M., Suba, E., & Zeigler, P. (2013). Carer+: Towards a digital competence framework for care workers in domiciliary care. In M. F. Paulsen & A. Szucs (Eds.), *Proceedings of the European Distance and E-Learning Network* (pp. 589–602). EDEN.

Vermeire, L., & Van den Broeck, W. (2024). Digital futures: A signal-based approach to inclusive digital youth work for socially vulnerable youth. *Media and Communication*, *12*, Article 8160. https://doi.org/10.17645/mac.8160

VET-TEDD. (n.d.). *Micro Learning Programmes*. https://www.vet-tedd.eu/en/micro-learning-programmes

Villarroel, V., & Stuardo, W. (2022). Proponiendo una EdTech sustentable. Más allá de docentes powerpointers y clickerers en la Universidad. *RIED: Revista Iberoamericana de Educación a Distancia*, *25*(2), 241–258. http://doi.org/10.5944/ried.25.2.32620

Willig, C. (2001). *Introducing qualitative research in psychology: Adventures in theory and methods*. Open University.

About the Authors

María José Hernández-Serrano (PhD, BS PsychoPedagogy) is tenured lecturer on educational theory at the University of Salamanca (Spain). Her publications and leadership projects analyze the educational processes

and the study of the emerging competences and competence frameworks in the area of educational technology. Her current research interests include the transdisciplinary application of brain-based research to the educational context and virtual environments, the promotion of creative and critical uses of digital technologies, and the emerging uses of social media and transmedia in education.

Joe Cullen (MA, PhD, Dip Psych) is director of Arcola Research UK and Arcola Research Portugal, president of Associação Godinhela—Investigação e Desenvolvimento Social (AGID), Portugal, and professional partner at the Tavistock Institute, UK. He previously taught social sciences and evaluation and research methods at the Universities of Cambridge, Loughborough, Leeds, London Metropolitan, and the Open University, and was academic dean at the Tavistock Institute, London, where he also served as a member of the editorial board of *Human Relations*.

Barbara Jones (PhD, MEd, BSc) is a research fellow University of Manchester (2004–2024) including as an IBM–University of Manchester fellow, and now a research associate at Bibliometrica. Her research interests include technological change and innovation and the relationship between work, learning, skills formation, training, and innovation in distributed environments and emerging technology areas across different sectors and demographic cohorts. She has been involved in a wide range of national, European, and international research projects and is author of over 60 commissioned reports, chapters, and articles.

Noelia Morales Romo (PhD, BS Sociology) is tenured lecturer on sociology at the Faculty of Education of the University of Salamanca (Spain). She has been involved in national and European research projects linked to the sociology of education and disseminated her research advances in more than 60 articles and book chapters. Her research lines focus on social inequalities related to education in terms of gender, disabilities, migrations, digital gaps, and rural areas. Recently she has been interested in media and digital literacy teaching competences.