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Analysis of digital capital for social inclusion in educational context

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Abstract

This paper focuses on one of the aspects most investigated and monitored in recent years by the Digital Economy and Society Index on the digitisation process in Europe—human capital, with an in-depth focus on primary school teachers. Human capital is one dimension underlying school digital capital, closely related to integrating digital into daily practices. Starting from this framework, the paper will present the results of a survey on the digital competencies of teachers from five European countries (Italy, Spain, Lithuania, Romania and Poland), carried out in the framework of the European project Erasmus+ CAVE (Communication and Visual Education in homeschooling). This survey is preparatory to a training intervention and didactic experimentation on digital education, foreseen in the project, and used as a theoretical framework of reference for the DigCompEdu survey, promoted by the European Commission. The teachers' profiles, as the output of the research, will be able to give stakeholders a picture of the investment of schools and teachers, in terms of the application of digital competencies on different educational processes: classroom teaching, assessment, professional training, preparation of teaching materials for the lesson and the implementation of competencies, including digital ones, of students.

KEYWORDS
digital competences, digital education, digitalisation, inclusion, teaching

Key insights

What is the main issue that the paper addresses?

Through the analysis of a case study, the paper analyses the human capital of the Digital Economy and Society Index of a sample of teachers from five European countries.

What are the main insights that the paper provides?

The paper provides insights about the contextualisation of the DigComEdu European e-skills framework, comparing it with some digital capital scenario data.

INTRODUCTION

The process of digital acceleration, which in recent years of pandemic crisis has affected those contexts of formal socialisation such as schools, induces a critical reflection on the new responsibilities and new skills that digital education, as an interdisciplinary field between communication sciences and education sciences, must assume to ensure an adequate understanding of the sociocultural, ethical and pedagogical implications underlying the integration of communication technologies in educational systems.

Within the field of education, already in 2018 the Teaching and Learning International Survey (TALIS) promoted by the Organisation for Economic Co-operation and Development (OECD) highlighted how the percentage of primary school teachers for whom 'the use of ICT for teaching' was included in their formal education and training internationally is equal to 56% (in particular: Italy, 52%; Spain, 38%; Lithuania, 45%; Romania, 70%; Poland, not available) (OECD, 2019). If we refer, instead, to the number of teachers who claim to be 'well prepared' or 'very well prepared' for the use of ICT in teaching, the percentage drops to 43% (Italy and Spain, 36%; Lithuania, 57%; Romania, 70%). The very results of the 2018 TALIS show that only 18% of the teachers surveyed use ICT skills for teaching, about 60% include the use of technologies for activities related to their professional development and only 53% of them let students use devices for projects or project work. These data reflect the framework set by the Digital Economy and Society Index (DESI)[1] in 2021 with respect to human capital on the basic and advanced skills of citizens in the field of ICT, which requires implementation in at least 12 European countries (European Commission, 2021).

The report *Digital economy outlook 2020* (OECD, 2020) analyses how the COVID-19 pandemic has amplified both the opportunities and challenges of the digital transformation that is affecting the economies and societies of OECD member countries. It confirms, therefore, how technologies have proved essential in the management of the epidemic and how this has further accelerated the already rapid pace of implementation of digitalisation, while significantly hitting also the public sector, which proves to be generally slower in times of technological transition because of its large size and bureaucratic management.

However, the surveys have also highlighted significant issues of the digital divide, resulting both from structural deficiencies and delays in terms of technological-infrastructural adaptation of organisations and local authorities, as well as situations of digital illiteracy that are still extremely high among citizens. In particular, concerning schools, the 2022 SUPI report on social precariousness by Eurispes (Fluxa, 2022) presents a comparison of the policies and strategies activated by the educational systems of several European countries

during the lockdown period, highlighting four main transversal factors of inadequacy within the education sector during the pandemic: (1) time to effectively manage the school organisational system in an emergency situation; (2) adequate training of school staff to cope with the emergency and acquire sufficient skills to design digital educational pathways while safeguarding the quality of education; (3) the absence of official guidelines by government bodies that, while respecting the school's autonomy, provide unambiguous guidance on the tools, strategies and teaching methods to be activated in these specific circumstances while preserving the differentiation of students; (4) infrastructural and technological—but also human and cultural—resources to manage the new digital education system in the medium term during the period of prolongation of the pandemic. The increased need to exploit the potential of digital technologies has fuelled the demand for high-quality connectivity, exacerbating the existing digital gaps between the various social components; this highlighted the need for a more inclusive approach to digital transformation.

These international scientific reports certainly contribute to reconstructing the reference scenario concerning the use or non-use of digital in the school context and the digital skills of teachers, however, there is a lack of precise references on the type of activities disseminated in the classroom with digital, and on the type and skills possessed by teachers. An in-depth study in this direction certainly represents the first step to be taken to launch any project proposal whose objective concerns the implementation and integration of digital competencies in schools.

In line with the objectives set by Europe 2030 and the European Green Deal strategy, the education system is also involved in the process of transition to digitalisation, about sustainability issues, in a long-term perspective ranging from 2030 to 2050, oriented towards initiating structural and methodological transformations, about the models of delivery and transmission of knowledge, to the skills of its actors, and the organisational and managerial structures of schools.

According to the European framework of digital competencies for educators (DigcompEdu 2.0), this paper poses some research questions: What is the level of digital competence of primary school teachers? What is their level of experience in the integration of digital devices as tools for social inclusion? How does the digital capital of schools influence the type and level of digital competence of teachers during the teaching process?

To answer these questions, the paper proposes the analysis of a case study entitled CAVE (Communication and Visual Education in homeschooling), Erasmus+ KA2, developed from 2020 to 2023 in five European countries (Italy, Romania, Poland, Lithuania and Spain). In the presented case study, the exploratory analysis of the digital competencies of primary school teachers is limited to these five European countries, proposing a critical reflection of the results also concerning the DESI data.

In this paper we introduce a training and didactic experimentation proposal, devised within a European project, which, starting from an international definition of the term 'inclusion', proposes services and tools to facilitate it through the use of visual communication tools. The achievement of this objective presupposes a preliminary definition of the educational needs of the teachers involved in the project in terms of digital competencies (as the basis of the 'human capital' DESI indicator). Through the presentation of the results of an evaluation questionnaire, administered before the actual delivery of the project, it is possible to contextualise the main outputs of the project, aimed at the implementation of digital competencies of all the school actors and the innovation of teaching practice through the exploitation of the potential of the tools and methods of visual and multimedia communication.

RESEARCH DESIGN

The European Commission's communication of 30 September 2020 on achieving the European Education Area by 2025 (5) defines inclusion as one of its key objectives. In the

Eurydice Report 2022: *Towards equity and inclusion in higher education*, 'Inclusion is an objective that has both an individual and a societal basis. Education is a human right, enshrined in both Article 26 of the Universal Declaration of Human Rights (18) and Article 2, protocol 1 of the European Convention of Human Rights (19). Therefore, the opportunity for each individual to benefit from quality education is an important aspect of our understanding of societal responsibility. Furthermore, investment in education is an investment in personal and societal development. In this sense, inclusion is at the heart of our understanding of democratic culture. We cannot accept limitations on citizens' rights to education as this would be counterproductive for both citizens and society'.

The complex framework of sociocultural and digital inequalities, which the period of health emergency from COVID-19 has revealed and amplified, is the subject of public and scientific debate even in academic circles, to identify pathways that meet the training needs of teachers on the digital issue. A proposal of La Sapienza, in this regard, calls into question the Department of Planning, Design and Technology of Architecture, especially that corpus of teachers and researchers active in the field of design of visual and multimedia communication, within a European network of primary schools and unions—for the school has put forward a proposal for technological didactic solutions for the development of inclusive teaching.

CAVE is a European project started in 2020 under Erasmus+ that aims to lead primarily teachers, but also students, towards knowledge and wisdom; inspired by the myth of Plato's cave, the project uses visual representation (visual storytelling) and especially pictograms (which recall rock marks), thus stimulating all participants to overcome physical, cultural and social barriers that have always conditioned traditional learning and teaching, especially during the pandemic period.

The objectives of the project were mainly:

- To support teachers in the construction of satisfactory communication relationships that meet the learning needs of students through the/in the development of pedagogical methodologies for digital teaching.
- To innovate the languages of dissemination, communication and transmission of educational content overcoming forms of sociocultural, economic and psychological, cognitive and emotional inequality of individual students.
- To promote collaborative and interactive forms of teaching that support truly meaningful learning processes for students and that stimulate collaboration and sharing of content and resources also within the teachers and school community.

The project, while taking its cue from the condition of the global health crisis generated by COVID-19 between 2020 and 2023, widens its gaze by framing other types of precariousness already manifest before the pandemic and equally critical in compromising the path of school socialisation among children. Among these, we can include (1) individual health precariousness, determined by physical fragility or degenerative diseases that may affect educational continuity; (2) geographical precariousness, determined by conditions of forced isolation due to natural disasters; (3) all situations of precariousness which may compromise the regular flow of school education for social, cultural, political or economic reasons that do not necessarily depend on the individual's will.

In this sense, CAVE wishes to offer food for thought and opportunities for experimentation for primary schools, in order to identify innovative strategies and alternative educational paths, in which digital technology can be a useful support for the reduction of the various forms of sociocultural disparity, thanks to its ability to combine the potential of different languages and its multidisciplinary nature conducive to the reduction of linguistic inequalities or generated by cognitive, psychological and physical deficits.

The main priorities of the proposal are three:

1. Reinforcing the development of key competencies (school education), through the enhancement of digital, notional and transversal competencies of teachers, who do not seem psychologically, pedagogically and didactically ready to dematerialise their relationship with students. In this sense, the project intends to link to the two additional priorities identified by the European Commission under the Digital Education Action Plan, related to digital education to: (a) improve the quality of the pedagogical use of technologies in teaching and learning processes; and (b) foster the development of digital skills of teachers and students to cope with contemporary sociocultural changes (European Commission, 2018) through adequate digital training (Bulger & Davison, 2018; Hartai, 2014; Hobbs & Tuzel, 2017). In this regard, the theoretical reference frameworks regarding the digital competence considered by the project are DIGCOMP (Ferrari, 2013) and subsequent updates, with reference to critical analysis, creative production, communication and collaboration, and problem-solving (Carretero et al., 2017) and DigCompEdu (Punie & Redecker, 2017) with reference to the following areas: (a) 'teaching and learning', which calls for the use of technologies for innovation, especially in terms of improving communication and the transferability of educational content to students through integrated digital teaching; (b) 'digital resources', inviting teachers to use innovative media languages, with particular attention to visual and multimedia languages to prepare teaching material; (c) 'learner's empowering' on the implementation of students' transversal skills, also using digital tools and an engaging and participatory teaching methodology; and (d) 'assessing', relating to the design and application of evaluation methods and tools adaptable to the pathways of digital education.
2. Social inclusion (horizontal) of children, through a proposal of didactic experimentation close to the languages and environments of mediated socialisation of the new generations. This priority aims to work in several directions: (a) the reduction of dispersion and school dropout of students resulting from demotivation and de-responsibilisation, which had already emerged during social isolation at home and could easily be replicated in a situation of distance teaching; (b) the weakening of different types of barriers—from the language barriers of immigrant children to the cognitive barriers of children with SLDs,[2] from the geographical barriers induced by the health emergency condition to the sociocultural family, often determined by the different availability of technological endowment, economic capital and cultural and digital background, and finally those barriers linked to the digital capital of the same schools in proposing activities through distance teaching.[3]
3. The fight against disintermediation, accentuated by the individual isolation of students in the private space of the home, by intervening in the difficulty of interpreting the multiplicity of information conveyed by the different media, and awareness of the appropriate use of shared media and content.

In the case of students, the project intends to implement digital skills of communication and collaboration between peers and teachers, in addition to critical skills in social languages through a pre-socialisation path to the languages of social media, as well as to the characteristics of interfaces and rules of safe use, through the development of a prudent and conscious attitude in the use of the services of social platforms and multimedia content.

The research design of the project was structured in three main work packages (WPs) to achieve three main intellectual outputs:

WP1 Survey of the digital skills of primary school teachers using an online questionnaire. The result of the analysis was functional, to design and develop online training paths to reduce potential gaps in the digital field. The final intellectual output connected to this action was the development of an online training course, entitled 'School-telling'.

WP2 Analysis of the digital and social capital of the schools involved in the project, using the online information of the schools. This action was instrumental in the design and development of an online social platform to implement collaboration and social inclusion of the teachers and students involved in the project.

WP3 Evaluation of the effectiveness and quality of the proposed project activities using different tools: (a) learning tests linked to the training activities (WP1); (b) focus groups with the teachers on the training courses undertaken (WP1); (c) analysis grids on the accessibility of the proposed digital services (WP2). The intellectual output of this work package was a repository of the evaluation tools and results developed and tested during the project.

The digital skills of teachers: Structure of the survey

Sample descriptions and profiles

In this subsection, we give a preliminary profile of the primary school teachers involved in the European CAVE project, who by 30 June 2022 spontaneously participated in an exploratory survey (within the project) by filling out an online questionnaire on their digital skills. One of the main objectives of this initiative was to verify the level of knowledge and digital competence of primary school teachers in five European countries (Italy, Spain, Romania, Poland and Lithuania).

The reconstruction of the digital knowledge and skills framework of the teachers involved was central to identifying the digital training needs of the project target group and identifying actions to implement these skills within the project, to initiate sociocultural inclusion paths through the exploitation of the potential of communication technologies.

The theoretical reference framework taken into consideration in the survey, and also for the structuring of the online questionnaire, was the digital competence framework DigCompEdu (Punie & Redecker, 2017), articulated as six areas of digital competence corresponding to six contexts in which technology can be socially integrated by teachers in their professional experience to achieve different educational objectives. Within the framework, for each of these areas of expertise, six profiles of digital educators (corresponding to six levels of digital competence) have been identified, which we will frame within our survey sample, each of which has specific digital skills and abilities. These profiles are summarised below:

1. Newcomers (A1) are educators who are aware of the potential offered by digital technologies for the enhancement of teaching and learning but possess poor media competence. The technologies are therefore mainly used for organisational and administrative purposes and constantly require expert support.
2. Explorers (A2) are educators who, in addition to awareness, have an interest and motivation to explore new educational opportunities offered by digital, are mainly self-taught and possess experiential skills, while they often lack method in the systematic use of technologies to improve their professional performance.
3. Integrators (B1) are educators who use technologies in different contexts and for equally variegated objectives, to improve their competence and teaching practice.

Such teachers, however, still have difficulties in choosing and selecting digital activities and the most effective devices for carrying out specific tasks based on the context and the target audience; in this sense, they need further experience and practice in the field.

4. Experts (B2) are educators who use media creatively and critically to improve their teaching activities and select the technologies considered most effective in specific contexts while recognising their advantages and criticalities. They are certainly innovative in the field of education and aware that they can further improve and learn.

5. Leaders (C1) are educators who use technologies flexibly and autonomously, creatively and critically, and put themselves at the service of colleagues to teach and spread best practices and new training methods, also improving the skills of colleagues.

6. Finally, pioneers (C2) are the educators who experiment with the digital avant-garde to improve performance and further innovate teaching practice, develop new pedagogical approaches and become a reference point for other colleagues.

The survey, conducted within the European CAVE project, was launched in April 2022 and involved about 392 primary school teachers until December 2022. The sample is therefore made up of primary school teachers aged between 23 and 67, many of whom teach scientific disciplines (e.g., mathematics and science), foreign languages and technology, from different European countries that are partners of the project, as listed in Table 1.

Instruments, sources and scales

The instrument used in the survey is a self-assessment questionnaire with closed answers, administered online via the digital platform of the European CAVE project with a preliminary registration of the teacher-compiler. The questionnaire, developed starting from the DigCompEdu European framework, is therefore configured both as an analytical survey tool and as a validation of the underlying theoretical model. The structuring of all questions for each of the six areas of DigCompEdu and the response alternatives methodologically followed all the indications provided in the official document promoted by the European Commission on the international framework (Punie & Redecker, 2017).

The structure of the questionnaire, organised in areas and indicators, is summarised as follows:

TABLE 1 Teachers involved in the European CAVE project.

Countries of CAVE network	Involved teachers (AV)	Involved teachers (val%)
Italy	74	18.9
Lithuania	85	21.7
Poland	65	16.6
Romania	110	28
Spain	58	14.8
Total	392	100

Note: Data elaboration from European Project Erasmus+KA2 CAVE 2020–2023 (392 cases).

Structure of the questionnaire	
Area	**Indicators**
Background and qualification of school	No. of digital training projects
	Availability of digital infrastructures
	Geographical position
	Population of the school (total no. of students)
Personal information	Age
	Gender
	Subject teaching
	Education
Professional engagement	Organisational communication
	Professional collaboration
	Reflective practices
	Digital continuous professional development (CPD)
Digital resources	Selecting digital resources
	Creating and modifying digital resources
	Managing, protecting and sharing digital resources
Teaching and learning	Teaching
	Guidance
	Collaborative learning
	Self-regulated learning
Assessment	Assessment strategies
	Analysing evidence
	Feedback and planning
Empowering learners	Accessibility and inclusion
	Differentiation and personalisation
	Actively engaging learners
Facilitating learners' digital competence	Information and media literacy
	Digital communication and collaboration
	Digital content creation
	Responsible use
	Digital problem solving

Each of the response items provided in all questions of the questionnaire was given a preliminary value by the researcher within a range from the minimum digital competence of *newcomers* to the maximum digital competence of *pioneers*. This allowed the researcher to identify the average value achieved by each teacher involved in each of the six DigCompEdu competence areas.

Finally, some of the questions in the questionnaire focused on digital infrastructure and investment in the schools in teacher training about digital culture.

The analytical process of digital skills of the teachers involved in the survey,[4] presented here, will be divided into two main steps: (1) a first exploratory framework of a general nature, on the average number of teachers (expressed as a percentage) that have been identified within the different competence profiles previously introduced; (2) a more specific analysis on each of the six areas of competence of DigCompEdu, checking the weight of each area indicator in defining the type of competence achieved by the teachers involved.

DATA COLLECTION PROCESS: GENERAL TEACHER PROFILES ON DIGITAL COMPETENCES

Thus, from an initial general analysis of the results, the teachers involved in the CAVE project seem to identify themselves mainly in the profiles of *explorers* (25.6%) and *integrators* (25.1%) (see Figure 1).

Despite the public investment policies of recent years in the education system, at the European level, with respect to the implementation of the use of digital in the education system,[5] the levels of digital competence of teachers involved in the project still fluctuate from level A2 to B1.

According to the European Commission, explorers (A2) are aware of the potential of digital technologies and are interested in exploring them to enhance pedagogical and professional practice. They have started using digital technologies in some areas of digital competence, without, however, following a comprehensive or consistent approach. Explorers need encouragement, insight and inspiration (e.g., through the example and guidance of colleagues), embedded in a collaborative exchange of practices.

Integrators (B1) experiment with digital technologies in a variety of contexts and for a range of purposes, integrating them into many of their practices. They creatively use them to enhance diverse aspects of their professional engagement. They are eager to expand their repertoire of practices. They are, however, still working on understanding which tools work best in which situations and on fitting digital technologies to pedagogic strategies and methods. Integrators just need some more time for experimentation and reflection, complemented by collaborative encouragement and knowledge exchange to become experts.

As widely documented by the scientific literature of recent years, the pandemic crisis has certainly contributed to an acceleration—albeit forced—with respect to the integration of digital in school contexts, especially regarding the implementation of the infrastructure of the school and the investment in digital training of the teachers themselves. The primary
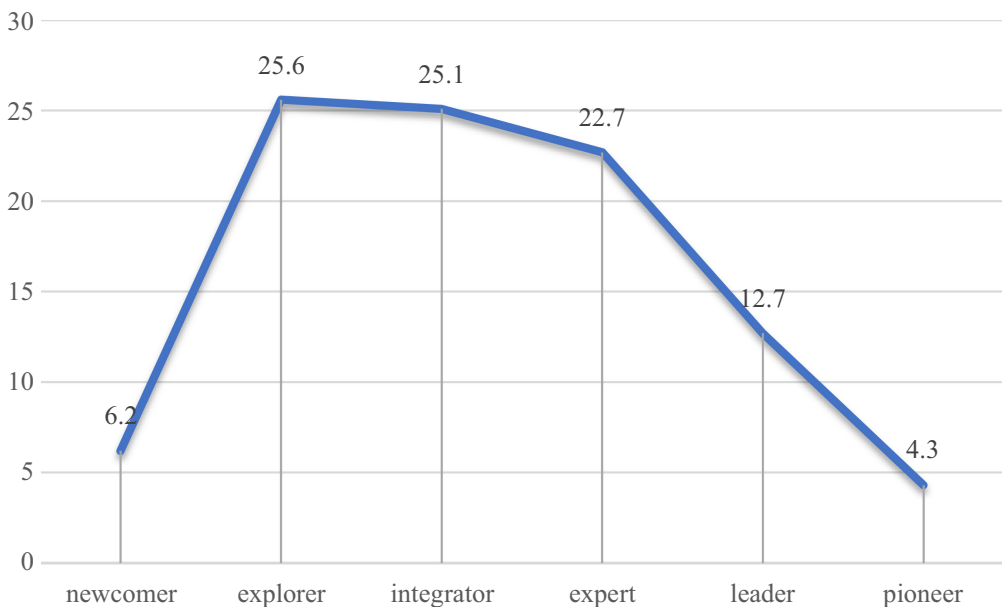

FIGURE 1 CAVE teachers' profiles on digital competence: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.

schools sampled in the survey themselves have a predominantly low level of digitisation (see Table 2).

This has helped to make teachers aware of the valuable contributions that technology can make to improving teaching and learning processes, not only in emergency situations. In this sense, the interest of many has increased to better deepen the actual educational opportunities that may arise from the world of teaching and learning technology; however, the approach to this complex system of knowledge and skills has often taken place individually, from personal experience, based on voluntary explorations. It is as if a good percentage of teachers had sought and built innovative educational paths starting from the needs of their class, as they had surfaced during the health emergency. The data therefore seems to reinforce the hypothesis that the infrastructure investment in digital has not been sufficient to reduce the intergenerational gap on digital and to start a process of integration of digital education in schools. The lack of knowledge on teaching methodologies applicable to digital education, or rather the lack of methodological educational paths on the educational integration of digital from the pandemic period, were the main considerations confirmed by the general analysis of the first research data. In the following subsections, we analyse in more detail the level of competence achieved by the teachers involved in the project for each of the six DigCompEdu competence areas.

Data analysis: Focus on teacher profiles in the six areas of DigCompEdu

Starting from the DigCompEdu framework, we focus the data analysis on the digital skills of the teachers involved in the survey, structuring the professional life of the teacher into three main moments: (1) the preliminary moment of educational performance in the classroom, which includes individual vocational training (area of professional engagement), as well as the online search of intangible resources essential for the management of teaching activities in the classroom (area of digital resources); (2) relating to the organisation and management of educational classroom activities with a focus on reinforcing teaching through the application of innovative strategies and methodologies (areas of teaching and learning and assessment); (3) relating to the implementation of students' learning processes through the use of digital (empowering learners and facilitating learners' digital competencies).

Professional engagement and digital resources

It is in the preliminary phase linked to vocational training that it is possible to find high-skill profiles of the teachers involved, who are mainly experts in the *professional engagement* area (27.8%) (see Figure 2a) and integrators in the *digital resources* area (32%) (see Figure 3a).

TABLE 2 Level of technological equipment of primary schools involved in CAVE project.

	Highest	**High**	**Low**	**Lowest**
Hardware	11.2	24.6	37.3	26.9
Software	13.8	26.9	42.9	16.4
Connectivity	10.4	18.3	50	21.3
Digital platform	3	16.8	51.1	29.1

Note: Data elaboration from European Project Erasmus+KA2 CAVE 2022 (392 cases).
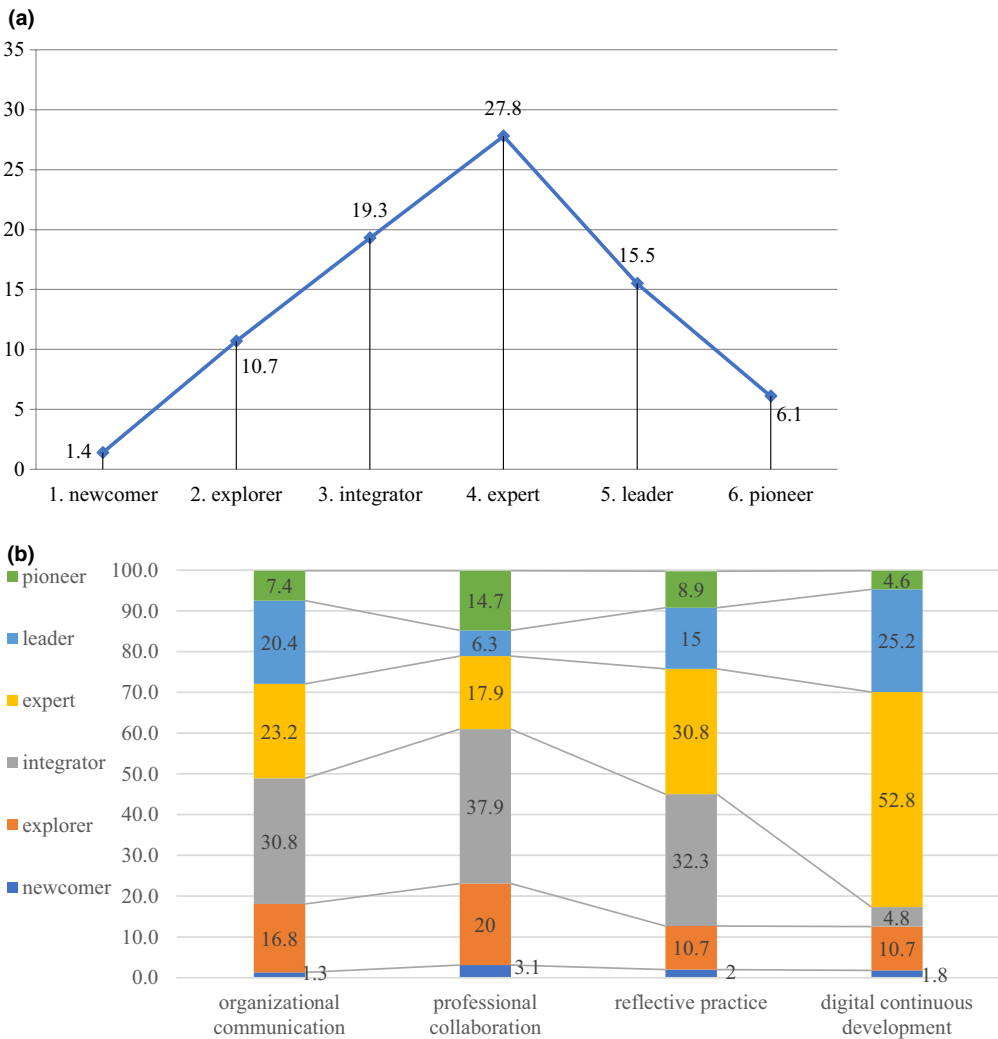
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FIGURE 2 (a) General profiles of CAVE teachers in the professional engagement area: DigCompEdu framework (val%). (b) Levels of digital competence of CAVE teachers for indicators in the professional engagement area: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.

It seems that the investment in digital education, implemented since the pandemic, has immediately shown positive effects on the teachers who have learned to effectively and critically select the resources deemed useful for their professional growth (theoretical and practical), focusing mainly on two main indicators: 'digital continuous development' (52.8%) and 'reflective practice' (30.8%), helping to increase motivation and interest in digital literacy (see Figure 2b).

The increase in online availability of open-source digital resources for teaching management since the pandemic period has helped to spread the habit of teachers selecting online resources (25.2%), using them by adapting to the learning objectives of the students (34.4%) and recovering and sharing the best practices of colleagues, ultimately to reapply them in their own training reality to achieve specific training objectives (36.2%) (see Figure 3b).
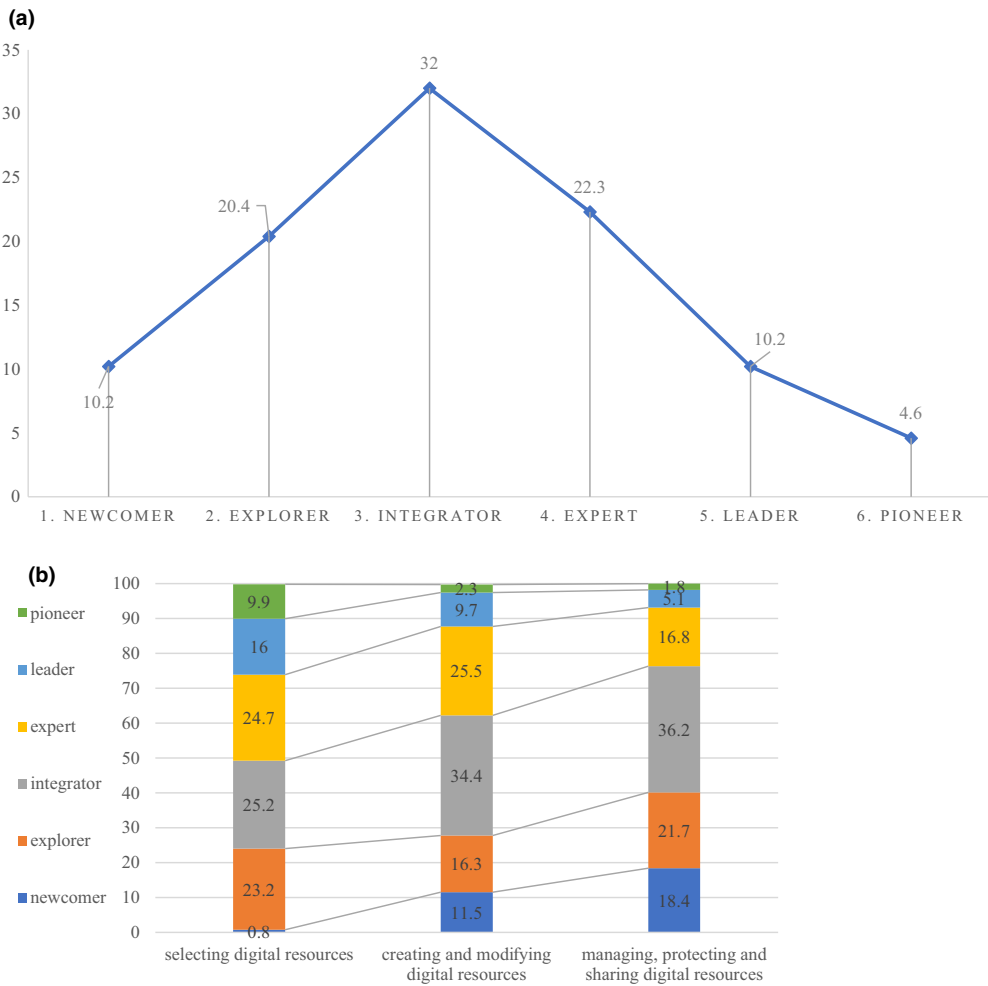
(a)

(b)

FIGURE 3 (a) General profiles of CAVE teachers in the digital resources area: DigCompEdu framework (val%). (b) Levels of digital competence of CAVE teachers for indicators in the digital resources area: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.

Teaching, learning and assessment

However, the degree of autonomy and creativity of the teachers involved in the research seems to lower when they must manage the teaching and evaluation processes through technology in the classroom with their students, demonstrating difficulties in applying innovative teaching methodologies that involve the use of technologies, or simply carrying out training activities with the media, able to implement the learning of their students. It is above all in teaching practices that those methodological criticalities, already found in other international research, are found (e.g., the Erasmus+ DECODE project had already highlighted in 2018 how pedagogical models underlying the use of ICT in teaching were still latent in the school system), which was anchored to the application of educational models also transmitted with technologies (Capogna et al., 2018).

These critical issues have been further emphasised following the COVID-19 emergency that democratised access to digital media in schools. In this context, we cannot underestimate the central role that long-distance teaching has assumed in recent years. Although

not identifiable as digital education, it is the most widely practiced educational method by teachers in recent years of crisis and it has often been associated with teachers' difficulties in initiating and putting into practice strategies of active involvement of students in order to avoid transposition teaching methodologies mainly transmitted in educational processes that are, by definition, relational and interactive.

In this sense, in the areas of DigCompEdu oriented towards the organisation and management of relational dynamics in the classroom, teachers are mainly explorers both in the *teaching and learning* area (35%) (see Figure 4a) and in *assessment* (27.5%) (see Figure 5a).
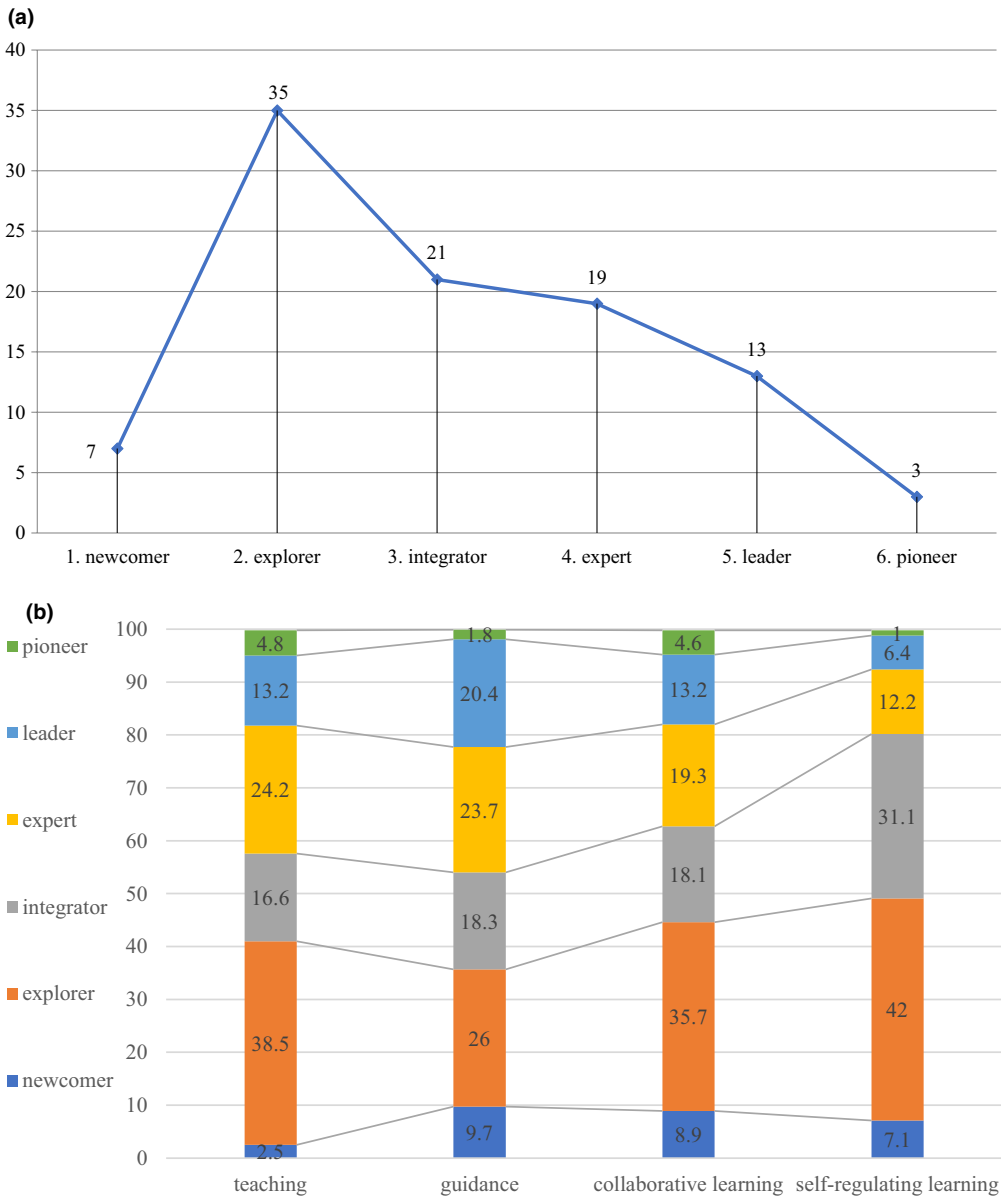

FIGURE 4 (a) General profiles of CAVE teachers in the teaching and learning area: DigCompEdu framework (val%). (b) Levels of digital competence of CAVE teachers for indicators in the teaching and learning area: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.
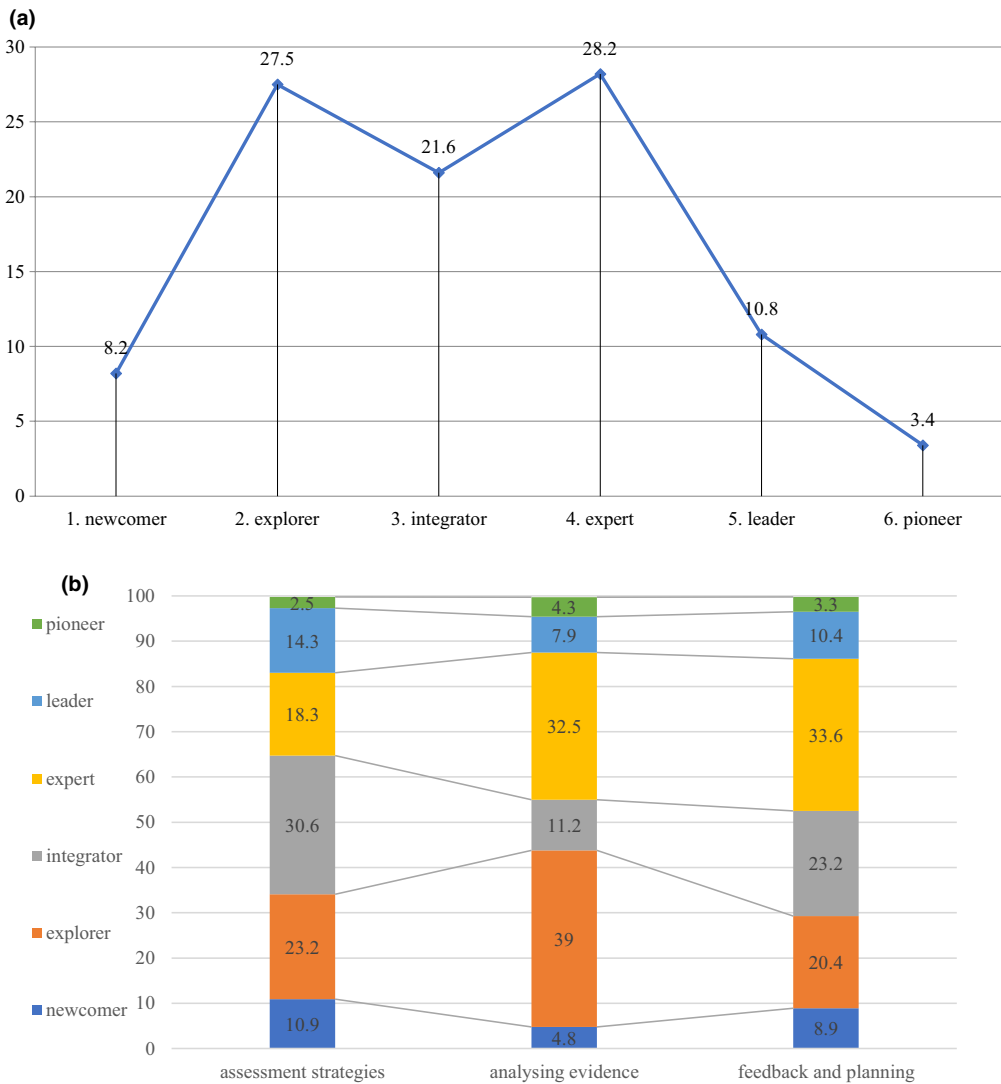
FIGURE 5 (a) General profiles of CAVE teachers in the assessment area: DigCompEdu framework (val%). (b) Levels of digital competence of CAVE teachers for indicators in the assessment area: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.

In the first case, teachers seem to orient their competence mainly towards self-regulation activities of the learning process of students in the classroom (42%), or cooperative learning (35.7%) and teaching (38.5%) (related to the teaching and learning area). In the assessment area, teachers seem experts in using digital technology mainly for the analysis of empirical evidence (32.5%) and in feedback and planning (33.6%) (see Figure 5b).

Student learning enhancement

In this context, the digital competence of teachers seems to improve again when media technologies are used to enhance student learning. In this sense, teachers are mainly explorers

in the *empowering learners* area (31.6%) and integrators in the *facilitating learners' digital competencies* area (28.8%) (see Figures 6a and 7a). Also in this case the teachers, starting from their preparation and motivation to learn, intervene individually in their school reality to stimulate the notional and transversal skills of their students following intuitions and subjective interventions, which are generally poorly systematised and shared, and therefore not necessarily transferable to other educational realities.

Specifically, compared to the empowering learners area, teachers seem to use media as integrators mainly to improve accessibility to student services and their sociocultural inclusion (31.9%), or to start courses of didactic personalisation and differentiation of the formative inputs based on learning differences (31.9). Finally, with regard to the implementation of students' digital skills (facilitating learners' digital competencies), the attention of teachers is mainly focused on the implementation of specific digital soft skills (Cortoni & Lo, 2018) such
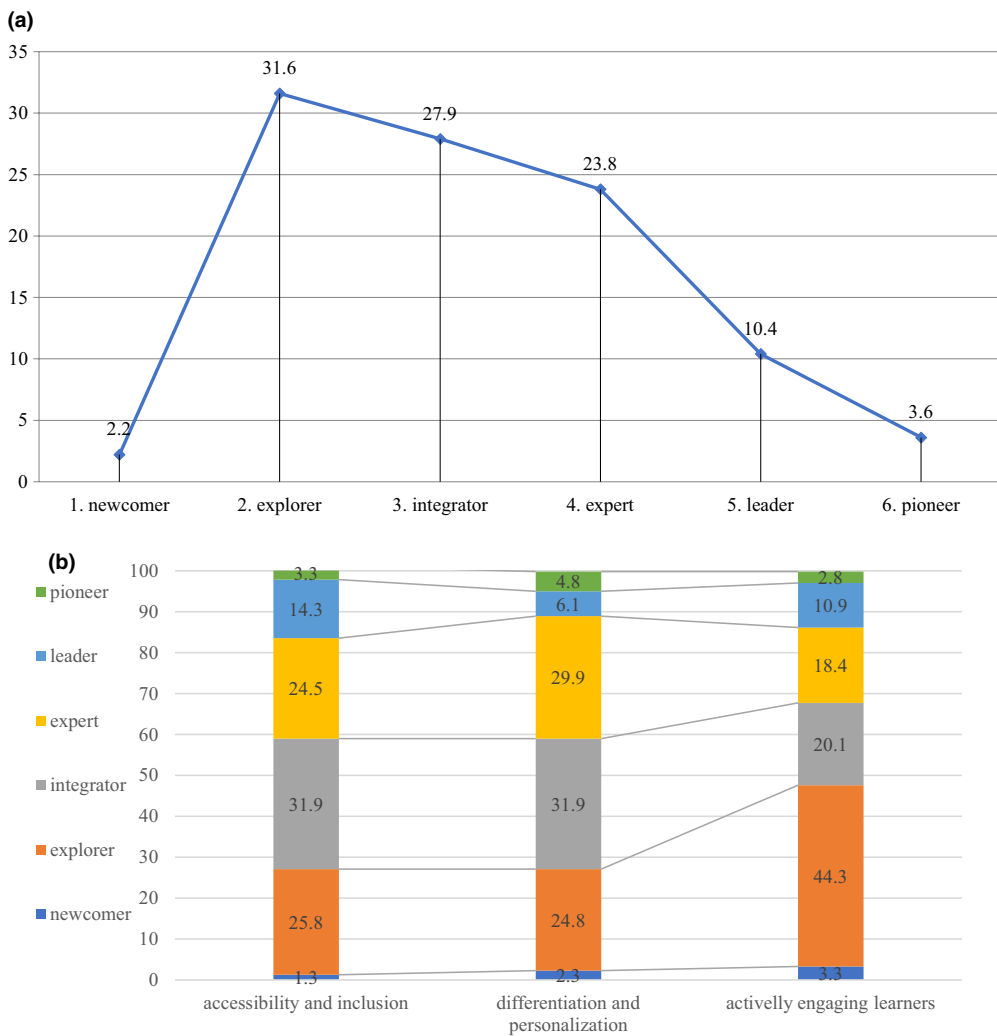

FIGURE 6 (a) General profiles of CAVE teachers in the empowering learners area: DigCompEdu framework (val%). (b) Levels of digital competence of CAVE teachers for indicators in the empowering learners area: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.
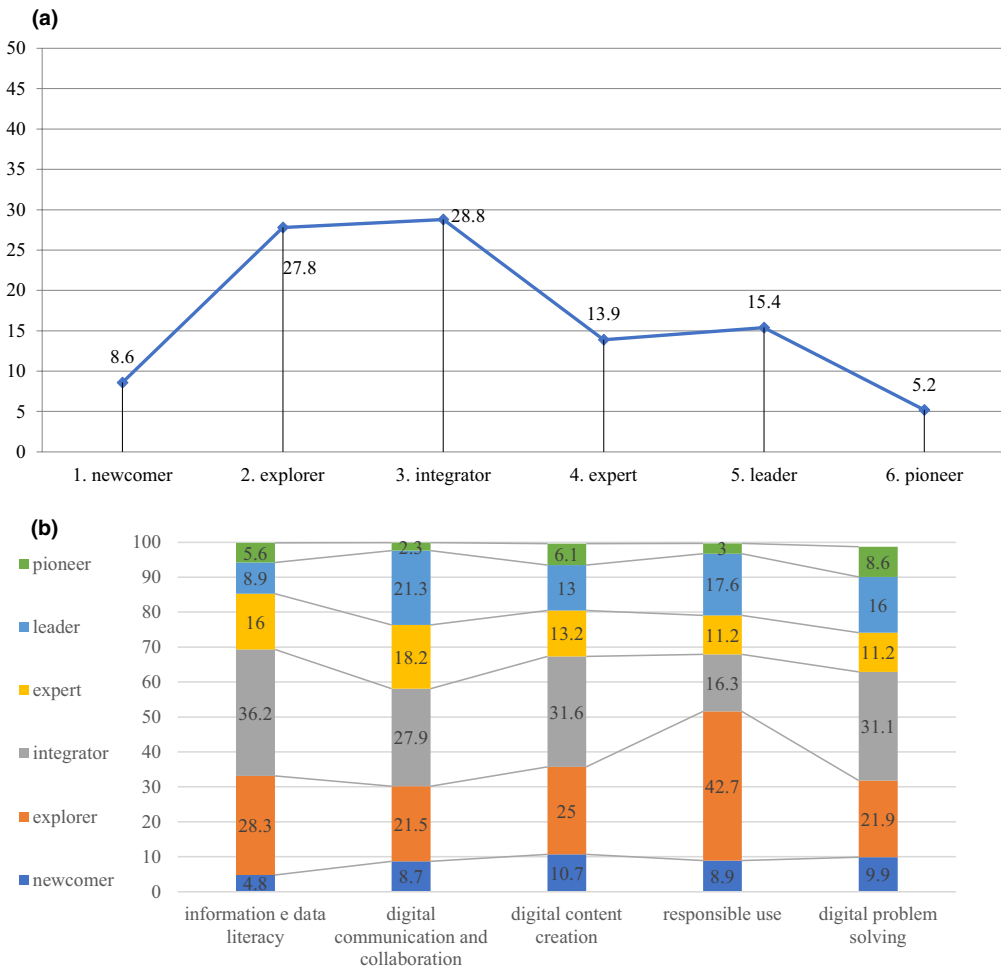
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FIGURE 7 (a) General profiles of CAVE teachers in the facilitating learners' digital competences area: DigCompEdu framework (val%). (b) Levels of digital competence of CAVE teachers for indicators in the facilitating learners' digital competences area: DigCompEdu framework (val%). *Source*: Data processing from the European project Communication and Visual Education in homeschooling (CAVE), Erasmus+ KA2, 2020–2023.

as information and data literacy as integrators (36.2%) for the stimulation of critical thinking, digital content creation (31.6%) and problem solving (31.1%) (see Figures 6b and 7b).

DISCUSSION

From the first results of the preliminary survey of the teachers involved in the European project, the average level of digital competence reached by the teachers involved is equal to that recognisable in the profile of integrators (B1). This is a low average level that needs to be implemented in order to develop creative innovation and critical didactic intervention through the use of technologies (a typical characteristic of the experts profile B2); to implement problem solving through the use of digital in cooperation with other colleagues so as to develop best practices that can be shared by other teachers (a typical characteristic of

the leaders profile C1); and to activate avant-garde digital training paths with revolutionary pedagogical approaches typical of pioneers (proficiency level C2).

The research results emphasise precisely how the use of digital competencies for teaching and learning in the classroom (teaching and learning area) and for the evaluation of the learning process (assessment area) is below the average B1 value. The training needs of the reference target of the European CAVE project therefore concern the implementation of digital competencies in the management of teaching and learning activities in the classroom with the students, reasoning on innovative solutions both with respect to the transmissibility of the contents through the use of visual and multimedia languages, and with respect to the methods of involvement of the students themselves in the classroom in the perspective of digital education.

The data from the questionnaire provide a generic snapshot of the average level of competence of the teachers in the schools involved in the project. The quantitative analysis should be supported by a qualitative analysis of contextual variables that can help to better understand the level of diffusion of digital competence among educators. However, the survey instrument is easily applicable and comparable with other macro-social data on the digital field, such as the DESI. This survey and analysis model, starting from a European framework on digital competences, can guarantee a comparability of references and data from the different European countries, allowing a transversal reading of the phenomena linked to digitalisation in the educational field.

Through this project, the discipline of communication design comes into play to stimulate reflection on the strategies and methods of planning of integrated digital education courses, in the context of digital education. The innovative methodological stimulation focused on the area of *teaching and learning* and *assessment* would inevitably also have some spillover effects on the other areas of DigComEdu (with particular reference to the area of 'digital resources' and 'empowering learners'), allowing them to be further implemented.

The work of critical reflection has focused mainly on at least two aspects underlying the principles of digital educational quality: (1) inclusive communicative languages as the basis of perceptive and cognitive processes and information storage; and (2) the design of the architecture underlying the environment of delivery of teaching in compliance with both the requirements of accessibility and usability for a very young target (e.g., children under 10 and their teachers) both of the relational and communicative dimension, weakened by social distance and digital mediation at school during the pandemic, and of the dimension relating to the safeguarding and protection of data shared and shareable online during the use of the same educational platform.

The main key intervention strategies of CAVE focus on three aspects, with respect to which innovative project proposals have been put forward. These are functional to the implementation of social inclusion and quality in the perspective of integrated digital education:

1. language;
2. method;
3. communication channel.

In the first case, during the didactic experimentation phase of the project, the aim was to adopt visual communicative codes based on better communication and transferability of teaching content both to teachers (during the training phase) and students. To this end, *information design* comes into play as a two-stage process: (1) the organisation of data (or content) from multiple sources of information; (2) their creation in graphic or representative form (*design*) (IIID, 2007; Manchia, 2020; Tufte, 1997). The final visual communicative artefact, therefore, is not simply reduced to a graphic transposition of a set of notions, but to a codified text, mainly syncretic (Polidoro, 2008),[6] in which it is possible to recognise a point of view,

a communicative style and a theoretical stance just like in a literary text (Manchia, 2020). In this sense, not only the result (the communicative artefact) but also the process of representation (Tufte, 1997) acquires relevance in the process of 'infographisation' of the informative and didactic content, which recalls a series of cognitive operations related to the reading of raw material, the selection of information, the reorganisation of concepts, the synthesis of data and their visual representation based on communication objectives or intentionality.

In the wake of *Isotype* (Neurath, 1973),[7] the adoption of a visual language, with the aim of 'explaining by images', recalls the democratic power of visual design or the possibility of transferring one or more items of information and/or knowledge in a clear way to masses of subjects not necessarily prepared on the proposed themes and with heterogeneous skills. In fact, the iconic language (mainly infographic) is easily recognisable and interpretable even by those who do not have adequate linguistic codes (e.g., immigrant students), by those who may have learning disabilities (dyslexia, dyscalculia, etc.), as well as students with different learning and expression times, starting from the different cultural stimuli of the family socio-cultural context.

In the second case, in order to stimulate the active participation of students and their cooperation, including between peers (Taddeo & Tirocchi, 2019), the project focus was on two methodological proposals: visual storytelling (Lankow et al., 2012), also understood as the link between storytelling and information design (Cortoni & Pandolfini, 2018); and the Munari method.

Visual storytelling, in its wide semantic meaning, is a cognitive method, aimed at understanding the surrounding reality and attributing meaning to the complexity of the surrounding events; it is a cognitive means to stimulate people's interpretive processes and to direct perceptions of reality, ideologies that can lead to social positions or actions. It is also an instrument of socialisation through which people can become aware of their identity, their emotions and their social role, and is a specific resource, in an educational context, to stimulate learning processes through laboratory experience and reflective observation of one's own work (Cortoni & Faloni, 2019).

Bruno Munari's design method is mainly based on the stimulation of visual creativity through play, focusing not so much on the outcome of the workshop (the visual product) but on the process put in place to achieve it. The peculiarity of Munari's approach lies in frequently stimulating the recipients to search for alternative ways of representation of the same object, identifying and discovering 'other possibilities' to explore the infinite aspects of the phenomena, without stopping at the already known stereotypes and representative uniqueness (Munari, 1981).[8]

The basic principles of communicative design, visual storytelling and Munari's design method have represented some of the main and innovative educational inputs proposed in the first intellectual output of the European project for educators, in order to implement, initially in primary schools, specific skills related to effective communication through the appropriate use of visual languages, as well as developing skills for the design of online classes using the rules of animation and visual storytelling, being able to coordinate moments of knowledge-sharing with moments of experimentation and implementation.

Finally, the communication channel that was chosen to experiment with the communicative relationship between teacher and student is a social media platform for educational purposes accessible through different devices, from smartphones to PCs, which mainly conveys visual content, with similar settings to those of Instagram (the most popular social medium among preteens). For this reason, the second intellectual output of CAVE has focused on the design and testing of a visual social educational network, addressed exclusively to students and primary school teachers and functional to support and ensure continuity in the activities proposed in the classroom, not only in times and situations of social insecurity but also throughout the regular teaching routine—thus inaugurating new

communicative, linguistic and relational modes that make school socialisation keep up with the transformations of digital culture, ensuring heterogeneity in educational relations between the different school actors.

The choice of the social visual environment as a communication and educational channel, in fact, meets two specific needs: (1) the stimulation of a relationship with the teacher, as well as peer to peer, and the use of visual language for communication easily accessible beyond disparities; (2) the choice of mobile devices as the main means of enjoyment of educational content by responding to the prerequisite of inclusiveness, insofar as this medium is generally owned and used by more than 90% of young people in Italy regardless of social, cultural, economic and technological disadvantages. The only precondition required is an active Internet connection. The use of this platform, from the educational point of view, can certainly contribute to the medium- and long-term implementation of some transversal and digital skills, such as:

- the ability for students to use online sources and re-process them appropriately;
- the ability to visually represent thoughts and content by learning to synthesise information and organise it by key concepts;
- stimulated online collaboration between peers and teachers, who acquire more authority;
- increased interest and curiosity about school topics, often labelled as boring or distant from the interests of learners, especially children.

CAVE's research findings fit within a broader European scenario where the investment in digital training for educators is becoming central to fostering media literacy among the younger generation. At the European level, there are many best practices of training intervention and experimentation projects in this area for school teachers and students; the CAVE project is just one and has focused mainly on the use of visual storytelling and Munari's approach as adoptable educational strategies to implement teachers' experimentation experiences in the classroom. The acquisition of digital skills, especially soft ones in any case, is a medium- and long-term process that can only be matured through teachers' teaching practice and daily classroom experience. The task of universities and research centres in this case can only be to support teachers with methodological tools and supports that can help them in the application of digital education paths in the classroom and their evaluation in terms of educational effectiveness.

CONFLICT OF INTEREST STATEMENT
The author has no conflict of interest to declare.

DATA AVAILABILITY STATEMENT
None.

ETHICS STATEMENT
None.

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ENDNOTES

[1] Since 2015, the Digital Economy and Society Index (DESI) has been monitoring the process of digitalisation of European Union countries using four main indicators: connectivity, human capital, the integration of digital technologies in organisational contexts and the implementation of digital public services.

[2] From the 2018 TALIS surveys, it emerges that about 18% of teachers now teach in classes with more than 10% of students whose first language is different from that of education, both concerning inequalities generated by learning disorders (SLD) and cognitive and physical deficits (SEND) knowing that, according to the results of the TALIS 2018 surveys, about 27% of teachers teach in classes with more than 10% of students with SLD and SEND.

[3] A study carried out on Spain's 2013 TALIS dataset showed that the use of ICT by teachers in the classroom depends not only on teacher training in ICT but also on cooperation between teachers themselves, the perception of self-efficacy and beliefs in teaching, as well as (albeit to a lesser extent) the availability of educational software or educational infrastructures (Gil Flores et al., 2017; European Commission, 2019, p. 29).

[4] From a methodological point of view, the data processing of the teachers' questionnaire on digital competence, used in the survey conducted within the European CAVE project, included bivariate analyses on the distribution of the different digital educator profiles (newcomers, explorers, integrators, experts, leaders and pioneers) both for each of the six competence areas of the DigCompEdu and for each descriptor of the competence areas provided. From the analyses, average percentage values were constructed on the number of teachers corresponding to each teacher profile per competence area.

[5] In 2012, the 'European Strategy for a Better Internet for Children' proposed the re-establishment of forms of cultural mediation in families and schools in order to adequately face the challenges of the digital age. In 2014, the 'European Audiovisual Policy in the Digital Era' invited member states of the European Union to implement good practices and research in the field of media literacy. In 2015, the 'Declaration on Promoting Citizenship and the Common Values of Freedom, Tolerance and Non-discrimination through Education' was introduced in Paris. In May 2016, in 'Developing Media Literacy and Critical Thinking through Education and Training', the European Council stipulated that all states of the European Union should provide for the development of media literacy and critical thinking at all levels. In 2018, through the report 'Teaching Media Literacy in Europe: Evidence of Effective Practices in Primary and Secondary Education', the European Commission provided some guidelines for developing media literacy curricula: to more systematically provide resources and adequate support to media educators; to raise awareness of misinformation and misuse of data in education; to invest in research of good practices in media literacy and media literacy education teaching; to promote collaborations with external territorial bodies on media literacy and media education issues; and to support the inclusion of digital skills assessment in the OECD PISA tests.

[6] We are talking about syncretic texts (Polidoro, 2008), which are texts capable of connecting multiple languages, from the verbal to the visual, in their different expressions (videos, photos, icons, drawings, etc.).

[7] *Isotype* is considered the first example of contemporary infographics.

[8] The Munari method goes from the identification of the problem to its detailed definition, to proceed with the research and analysis of the information related to the problem and then propose a solution with respect to the problem investigated, to be tested, verified and validated.

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