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Innovating in complexity: training, motivation and virtual reality in the pedagogies of the future

Martina Rossi [1]

[1] University of Foggia, Humanities Department; martina.rossi@unifg.it

Abstract: In recent years, the educational system has undergone profound transformations, accelerated by the pandemic and the growing integration of digital technologies. These changes have highlighted the challenges faced by students with disabilities and specific learning disorders, requiring a rethinking of educational environments from an inclusive perspective. In this context, Virtual Reality (VR) has emerged as an innovative tool capable of fostering accessibility, personalization, and active learning. However, the mere availability of technological resources is not sufficient: continuous teacher training, professional motivation, and pedagogical awareness remain essential. The study explored the relationship between digital training, motivation, and teachers' perceptions of the usefulness and ease of use of VR, involving 28 participants through an online questionnaire based on validated scales and specific instruments.
The results indicate a positive relationship between teachers' digital competence and motivation, showing a greater tendency to adopt educational technologies and to perceive VR as an effective and inclusive resource. When consciously integrated into teaching practice, VR can promote dynamic, participatory, and accessible learning environments. This evidence supports the idea that educational innovation depends primarily on the professional development and intrinsic motivation of teachers, rather than solely on technological availability.

Keywords: Virtual Reality, teacher training, futures pedagogies.

1. Introduction

In recent years, the growing use of digital technologies has profoundly transformed various aspects of society, culture, and daily life, driving significant innovation in education and teaching practices. One of the most notable changes has been the shift from a traditional teaching model, focused on the one-way transmission of knowledge, to a more interactive and participatory approach. Digital technologies empower students to take an active role in their own learning, offering access to a wide range of resources, collaborative tools, and online learning platforms (Ranieri, 2022). As a result, educators' attitudes, perceptions, and teaching methodologies have also evolved significantly, with an increasing focus on the need for teachers to develop advanced digital skills to keep pace with an ever-changing educational landscape. In this context, various national and international guidelines have emerged to provide both theoretical and practical frameworks. The European Council, in collaboration with the Joint Research Centre (JRC) of the European Commission, developed the "DigComp" or "Digital Competence Framework." This framework aims to define "digital competence" as the ability to use digital technologies in a safe, critical, and responsible manner for learning, social participation, and work. It also seeks to guide the development of policies that enhance digital skills, create and share tools for their assessment and certification, and design targeted training programs to support their acquisition (Peconio & Rossi, 2023).

The digital competence of teachers plays a crucial role in ensuring inclusive and high-quality education for all students. As Ulivieri (2018) points out, it is essential to focus on teacher training programs that equip educators with the necessary tools to address emerging educational challenges, thereby fostering a high-quality, equitable, and inclusive learning environment. By mastering advanced digital skills, teachers can effectively leverage technology to meet the diverse needs of their classrooms and promote educational equity. The ultimate goal is to design tailored and diversified learning pathways that address the individual needs of all students (Rossi, Peconio & Toto, 2023). In recent years, there has been a growing interest in the use of Virtual Reality (VR) hardware and software within the educational field. Researchers and experts in Higher Education are experimenting with and analyzing its application in learning processes to better understand its potential for promoting inclusion (Rossi et al., 2023). However, bringing this technology into classrooms requires a thorough understanding of teachers' perceptions regarding its use. The case study focuses on the Apulian school context, where the application of these technologies is still uncommon and often limited to experimental cases.

The main objective is to analyze teachers' perceptions of the use of VR from an inclusive perspective, exploring the relationships between training, motivation and predisposition to use digital technologies. The research question is: How do teachers' training and motivation influence the perception and use of Virtual Reality as an inclusive tool in education?

2. Educating educators: digital competencies for the future of teaching

Even today, the topic of teachers' digital skills is highly debated, both in schools and academia. This is because digital competence represents not only one of the main challenges for European education systems, but also an indispensable condition for fully exercising citizenship in the knowledge society. It is, however, a complex competence that cannot be reduced to a mere technical ability or to the simple capacity to use technological tools. Rather, it requires an integrated and flexible approach that combines technological, cognitive, and ethical dimensions, supporting processes of lifelong learning (Howard & Tondeur, 2023).

The concept of digital competence was officially introduced into European Union policy in 2006 with the Recommendation on Key Competences for Lifelong Learning, later updated in 2018. The document defines it as the ability to use digital technologies in a conscious, critical, and responsible manner for learning, working, and participating in society. Digital competence thus goes far beyond computer literacy: it encompasses digital content creation, online communication and collaboration, cybersecurity, and an ethical awareness of how individuals act and interact in digital environments.

According to Calvani, Fini, and Ranieri (2009; 2010; 2011), digital competence rests on three interrelated dimensions. The technological dimension involves the technical skills required to use digital tools effectively and to evaluate their potential for solving real-life problems. The cognitive dimension concerns the ability to select, interpret, and critically assess information, recognizing its context and credibility. The ethical dimension addresses the responsible and socially aware use of technologies, privacy protection, and an understanding of issues related to the digital divide. The intersection of these three dimensions generates a fourth, integrated dimension, that highlights the collaborative construction of knowledge and the fostering of meta-cognitive awareness in digital contexts.

Despite notable progress in recent years, European data reveal that Italy still lags behind other EU member states. According to the Digital Economy and Society Index (DESI, 2022), Italy ranks 18th out of 27, performing below the EU average particularly in the area of human capital. Only 46% of the Italian population possesses basic digital skills (compared to 54% in the EU), and ICT graduates represent merely 1.4% of the total, against the EU average of 3.9%. To address these gaps, the Italian government launched the National Strategy for Digital Skills in 2020, under the broader Repubblica Digitale initiative. This strategy is articulated around three main pillars: digital education, aimed at combating digital illiteracy and promoting civic awareness; digital citizenship, which encourages active and informed participation through technology; and an ethical, human, and inclusive approach to digital transformation. All three principles reinforce the idea that education and training are key drivers of sustainable economic, social, and cultural development. Within this transformation, teachers occupy a pivotal position. The digital competence of educators is not limited to the ability to use ICT in the classroom but extends to their pedagogical capacity to integrate such technologies in ways that enhance learning and inclusion. As Rivoltella and Rossi (2019) observe, the simple introduction of digital tools into teaching practice does not automatically lead to improved digital competence. Findings from international surveys such as OECD's TALIS 2018[1] and the 2nd Survey of Schools: ICT in Education (European Commission, 2019) show that although more than half of teachers' report having received training in ICT use, about 17% still express a strong need for further professional development. Barriers to technology integration often stem less from infrastructural limitations and more from insufficient pedagogical frameworks, lack of institutional support, and low teacher motivation. In response, several theoretical models and policy frameworks have been developed to guide teacher professional development in the digital era. Among the most influential is the TPACK model (Technology, Pedagogy, and Content Knowledge) proposed by Mishra and Koehler (2006). This framework argues that effective teaching in the digital age relies on the dynamic interaction between teachers' disciplinary, pedagogical, and technological knowledge. The strength of the TPACK approach lies in its capacity to represent the complexity of teachers' professional expertise and to help educators make informed decisions about how and why to use specific technologies. In Italy, these principles have been incorporated into national policies such as the National Digital School Plans (PNSD, 2012-2019) and the National Teacher Training Plan, which promote ICT use to renew teaching methodologies, strengthen disciplinary integration, and encourage inclusive, flexible learning environments. At the international level, the UNESCO ICT Competency Framework for Teachers (2014) further emphasized the need for a comprehensive vision of

[1] Preliminary results from the TALIS 2024 survey were presented at the launch event, held on October 7, 2025. The scientific and academic community is currently awaiting the full results. Therefore, the 2018 data are currently the most up-to-date. For more information, please visit the following website: https://www.oecd.org/en/publications/results-from-talis-2024_90df6235-en.html

teacher training, highlighting four key aspects: critical awareness of technological opportunities, cognitive and ergonomic reflection, professional development beyond technical mastery, and the collaborative design of teaching practices.

Aligned with this direction, in 2017 the European Commission's Joint Research Centre (JRC) launched the DigCompEdu – European Framework for the Digital Competence of Educators, which has since become a central reference for the digital upskilling of teachers and trainers. The framework identifies six competence areas divided into twenty-two sub-competences: professional engagement; digital resources; teaching and learning practices; assessment; empowering learners; and facilitating learners' digital competence. It also defines six proficiency levels, from Novice (A1) to Pioneer (C2), inspired by Bloom's taxonomy, which allow educators to map and monitor their progression through reflective, evidence-based practice. Building on DigCompEdu, the SELFIE for Teachers platform – introduced in 2021 – provides a free self-assessment tool that enables educators to evaluate their digital skills and receive tailored feedback for further development. This reflective approach encourages teachers to take ownership of their professional growth, transforming digital competence from an external requirement into a core component of their identity as educators.

3. Virtual Reality in education: opportunity or illusion?

In recent years, interest in Augmented Reality (AR) and Virtual Reality (VR) software within educational contexts has grown significantly. This trend has been further accelerated by the global COVID-19 pandemic, which highlighted the importance of accessible and engaging online learning environments. As noted by Di Tore and Arduini (2020), both AR and VR hold remarkable potential in education, particularly for their capacity to provide simulation-based learning experiences. These tools allow students to immerse themselves in realistic scenarios that encourage them to apply knowledge and skills to solve authentic problems. Although these technologies may appear relatively new, as early as 2011 the Horizon Report predicted that AR would soon become an integral part of teaching and learning processes, thanks to its ability to superimpose digital data onto the real world and thus enhance students' perception and understanding. AR and VR: Definitions and Origins Augmented Reality (AR) is commonly defined as the "enrichment of human perception through digitally processed information overlaid on the physical world by means of a device […] interposed between the user's eye and the surrounding reality" (Panciroli & Macauda, 2018). The term was first introduced in the early 1990s by researcher Tom Caudell at Boeing, who developed an AR-based system to guide engineers during aircraft assembly and maintenance. Virtual Reality (VR), on the other hand, refers to an artificial, computer-generated environment composed of images, sounds, and other sensory feedback designed to simulate real or imaginary settings (Smutny et al., 2019). The first digital VR system dates back to 1966, when the U.S. Air Force developed a flight simulator for military training (Rossi et al, 2023). The term Virtual Reality itself was coined by Jaron Lanier in 1987, who described it as a computer-generated, interactive, three-dimensional environment capable of fully immersing the user (Anderson, 2019). Pioneering efforts include Ivan Sutherland's 1968 head-mounted display, followed decades later by commercial headsets such as the Oculus Rift (2012), which popularised affordable and high-quality immersive experiences. Since 1989, numerous definitions have emerged, yet most converge on describing VR as a multisensory, interactive simulation that induces a strong sense of presence (Elmqaddem, 2019; Serin, 2020; Singh et al., 2021; Monfared et al., 2022; Lampropoulos et al., 2022). Two notions are central to the VR experience: immersion and presence (Jumani et al., 2022). Immersion refers to the objective, measurable degree to which technology envelops the user's senses, whereas presence is the subjective psychological sensation of "being there" – identifying with a virtual body and reacting to the environment as one would in real life (Gatto et al., 2021; Rossi & Toto, 2024). VR systems can be classified into three main categories (Caldarelli et al., 2023): Fully immersive VR, achieved through headsets such as Oculus, enabling real-time, multisensory interaction with 3D environments. Semi-immersive VR, which offers partial immersion through projection-based systems like CAVE (Cave Automatic Virtual Environment). Non-immersive VR, experienced via conventional screens, providing limited sensory involvement. While VR transports the user entirely into computer-generated worlds, AR overlays digital elements onto the physical environment, creating a hybrid form of perception. Both technologies converge in Augmented Learning – an educational approach that combines physical and virtual experiences to enhance comprehension, engagement, and motivation. Educational Applications of AR and VR AR enables the creation of dynamic and personalised learning environments, tailoring content to students' individual needs. Research shows that such interactive approaches foster active participation, emotional involvement, and improved retention (Rossi et al., 2023). However, challenges remain: limited digital literacy among teachers, the need for specifically designed didactic materials, and the high cost of hardware can hinder widespread adoption. VR, on the other hand, has proven particularly effective in experiential and hands-on learning contexts (Lee et al., 2024). It allows learners to practise complex tasks safely, repeat activities, and experiment freely without real-world risks. Singh et al. (2021) identify five key characteristics of effective VR educational software: Emotional connection with learners; Ease of use and intuitive interfaces; Meaningful learning supported by strong storytelling; Flexibility and adaptive feedback; Clear progress tracking and performance analytics. VR supports student-centred pedagogical models, emphasising autonomy, problem-solving, and critical thinking (Caldarelli et al., 2023). The technology facilitates constant feedback and immediate evaluation, reinforcing self-efficacy and engagement (Rossi, 2022). Moreover, it opens the door to otherwise inaccessible learning environments – such as exploring volcanoes, flying aircraft, or visiting ancient cities – expanding educational frontiers (Serin, 2020). Multiple educational applications exemplify these opportunities: MozaiK Education, a platform rich in 3D scenes and immersive resources; Unimersiv and Discovery VR, offering virtual exploration across subjects; ClassVR (Eduverse), which provides thousands of classroom scenarios; Boulevard, that brings virtual museum experiences to schools. Parallel AR-based tools include Animals 4D, VisualMath 4D, and MOSOCO, each enhancing visual understanding, collaboration, and social learning. Learning With and Within the Metaverse AR and VR technologies are at the core of the emerging Metaverse, which extends immersive learning into persistent, shared, and interactive virtual environments. The Italian "Piano Scuola 4.0" (2022), part of the National Recovery and Resilience Plan, explicitly refers to the Eduverse as a bridge between physical and virtual learning spaces, fostering "onlife" education. Contrary to the belief that it is a recent concept, the term Metaverse dates back to Neal Stephenson's 1992 novel Snow Crash, describing a parallel digital universe where users interact through avatars (Stephenson, 1992). Today, this concept has evolved beyond science fiction into a multidisciplinary field combining VR, AR, Artificial Intelligence, Big Data, Blockchain, and Digital Twins (Lin et al., 2022). In educational research, the Metaverse is often defined as a three-dimensional, social learning space enriched by immersive and adaptive technologies (Messina, 2023; Park & Kim, 2022). Learners, represented through avatars or digital twins, can explore, collaborate, and co-create content, blurring the line between reality and simulation. According to Lin et al. (2022), the Metaverse reshapes education in at least seven ways: Creating immersive and interactive experiences; Enabling visualisation of otherwise intangible objects or concepts; Reducing risks and costs through safe simulations; Overcoming temporal and spatial limitations; Preventing academic misconduct via blockchain technologies; Enabling highly personalised and inclusive learning; Strengthening communication and immediate feedback. These affordances make the Metaverse a powerful tool not only for STEM or language learning (Yoo & Chun, 2021) but also for soft-skill development, such as collaborative problem-solving and public speaking. Applications like Ovation allow learners to practise presentations in realistic virtual settings, addressing anxiety and boosting confidence (Huston, 2022). Metaverse, Virtual Reality, and Educational Inclusion Beyond its technical innovation, the Metaverse – and, more broadly, AR and VR – offers transformative potential for inclusive education (Cheung et al., 2022; Seigneur & Choukou, 2022). These technologies enable teachers to design customised learning experiences for students with disabilities or special educational needs, fostering participation, autonomy, and self-esteem (Rossi et al., 2023). Empirical studies confirm these benefits. For example, Cheung et al. (2022) used VR simulations to teach social and daily-living skills to students with intellectual disabilities, achieving measurable gains in autonomy. Burke et al. (2018) found that simulated job interviews in VR increased participants' self-awareness and reduced anxiety. Root et al. (2021) demonstrated how VR supports mathematics learning among students with autism, while Kang & Kang (2019) highlighted its role in adapted physical education, offering safe, personalised, and motivating experiences. Such applications also align with Universal Design for Learning (UDL) principles (Di Martino & Longo, 2019), as AR and VR technologies provide multiple means of representation, engagement, and expression. They encourage cooperative learning, gamified education (edutainment), and creative exploration, enabling all learners – regardless of ability – to actively participate. As Chiesa et al. (2020) observe, immersive VR "allows students to inhabit the scene of learning itself," integrating visual, auditory, and kinesthetic dimensions in inclusive ways. In essence, immersive technologies not only diversify teaching approaches but redefine the very architecture of educational inclusion. By merging sensory engagement, emotional motivation, and cognitive depth, AR and VR help transform classrooms into adaptive ecosystems of participation, bridging the gap between opportunity and what once seemed like science fiction.

4. Introduction to the study

In light of the previous reflections on the role of immersive technologies in education, it is evident that AR and VR hold significant transformative potential for inclusive teaching. These innovative tools, capable of creating authentic and engaging learning experiences, are redefining the very notion of accessibility, participation, and personalized education at school. In Italy, the Piano Scuola 4.0 (Ministerial Decree No. 161/2022) officially introduced the concepts of the Eduverse and the Metaverse, emphasizing the importance of integrating physical and digital environments into a single, interconnected learning ecosystem. Within this framework, the educational environment is conceived as a dynamic and interdependent system in which people, resources, time, and activities interact in a continuous learning process. In accordance with Bronfenbrenner's ecological perspective (1989), every component of this system contributes to the construction of meaningful, collaborative, and inclusive learning experiences, fostering active engagement and the development of transversal competences (Costa & Baschiera, 2024). However, technological innovation alone is not sufficient to ensure effective educational transformation; teacher training plays a decisive role. As Costa and Baschiera (2024) affirm, educators today must combine disciplinary expertise, pedagogical competence, and digital literacy to navigate the challenges of contemporary education. A well-prepared teacher is no longer a mere transmitter of content but a facilitator of learning and a promoter of students' personal and social growth (Panciroli, 2021). Technology becomes truly effective when teachers understand its pedagogical potential and use it strategically to enhance accessibility and personalization. Research shows that a thoughtful and reflective use of digital technologies can strengthen teachers' motivation and self-efficacy (Backfisch et al., 2020; Sharma & Srivastava, 2020; Braje & Topčić, 2023). According to the TPACK model (Mishra & Koehler, 2006), the successful integration of technological, pedagogical, and content knowledge allows educators to design coherent and innovative teaching practices. In line with Bandura's theory of self-efficacy (1997) and the Self-Determination Theory (Deci & Ryan, 2000; 2016), well-designed digital training fosters professional confidence, autonomy, and intrinsic motivation, which are essential for embracing educational innovation. Within this framework, understanding the pedagogical value of Virtual Reality becomes a central goal: without specific and well-structured preparation, VR risks being perceived as a merely decorative or peripheral tool. Its educational impact depends instead on teachers' ability to integrate it critically and intentionally into learning processes, designing experiences that are accessible, inclusive, and aligned with curricular objectives. Building on these theoretical foundations, the present case study, conducted at the "Oasi" Paritarian Institute in Foggia, explores four key dimensions: teachers' digital training, their professional motivation, the use of digital technologies in classroom practice, and their perception of Virtual Reality as an inclusive educational tool.

4.1. Context analysis

The "OASI" Paritarian Institute, located in Foggia and managed by the non-profit organisation AS.SO.RI. Onlus, constitutes an inclusive and innovative educational environment committed to promoting social integration and the well-being of children with and without disabilities. AS.SO.RI. operates through an integrated network of educational and rehabilitative services that combine pedagogical innovation, technological integration, and systematic collaboration with families and the local community. The institute encompasses nursery, kindergarten, and primary school sections designed to ensure personalised learning, accessibility, and full inclusion. Its facilities include specialist laboratories, a gymnasium, two didactic swimming pools, a multimedia classroom, and an immersive learning room equipped with eight ClassVR headsets, positioning the school among the most advanced institutions in Southern Italy in terms of digital innovation. The teaching staff work within multidisciplinary teams of educators, psychologists, and therapists, providing continuous and targeted support to all students. Educational practices at the "OASI" Institute are based on experiential, learner-centred approaches that foster creativity, critical thinking, and active citizenship. The school's pedagogical vision aligns with the principles of the Piano Scuola 4.0 and the Three-Year Educational Plan (2022–2025), which prioritise inclusion, sustainability, and the development of digital and socio-emotional competences. Within this framework, the "OASI" Institute represents a model of educational innovation where technology, inclusion, and pedagogy converge to create a holistic and stimulating learning environment.

5. Objectives and research hypothesis

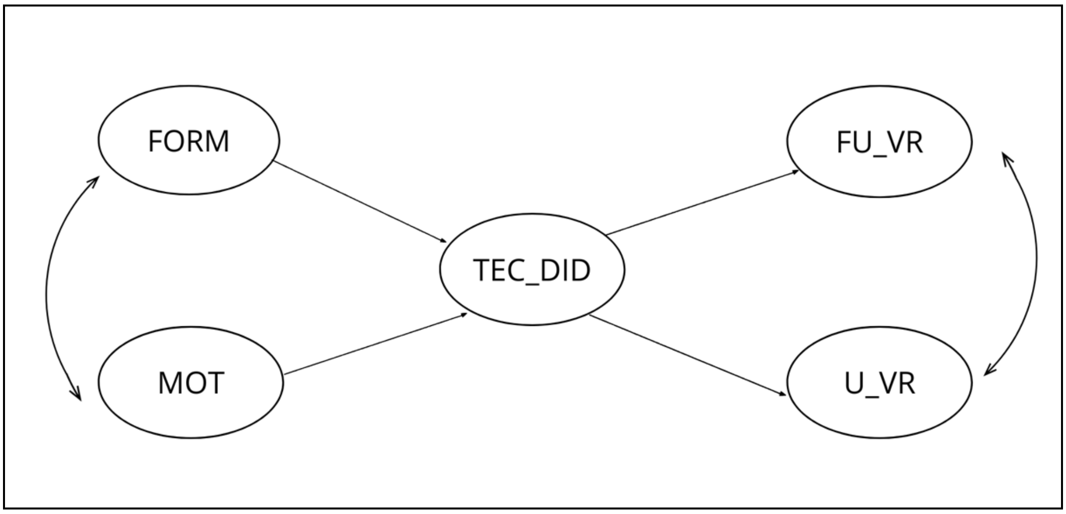
The objective of the study was to explore and understand the relationship between teachers' digital training and their motivation in relation to the perceived ease of use and perceived usefulness of Virtual Reality (VR) in teaching practice, with particular attention to its inclusive implications. Specifically, the research aimed to investigate how teachers' propensity to use digital technologies may mediate these relationships, influencing the effective integration of VR in educational contexts. The study was guided by the following hypotheses:

H1 – Digital education has a positive relationship with perceived ease of use and perceived usefulness of VR through the use of technologies in the classroom;

H2 – Motivation has a positive relationship with perceived ease of use and perceived usefulness of VR, through the use of technologies in the classroom.

It was therefore hypothesized that teachers who are more motivated and digitally trained are also more inclined to use educational technologies and that they tend to hold a more positive perception of VR in the classroom, in terms of both ease of use and perceived usefulness (Figure 1).

Figure 1. Model hypothesized in the research.
Note: FORM=Training; MOT= Motivation; TEC_DID = Educational Technologies; FU_VR = Ease of use of VR; U_VR = Usefulness of VR. All paths in the figure assume a positive relationship among the variables.



6. Method

6.1. Participants and procedures

The participants were recruited within the "OASI" Institute in Foggia. Recruitment involved a convenience sample identified through the mediation of the school's Headmistress. The study was conducted through the administration of a self-report questionnaire distributed via the Google Forms platform. At the end of the data collection process, the final sample consisted of n = 28 teachers and educators (82.1% female), with a mean age of 42.79 years (SD = 8.275) and an average of 9.39 years of teaching experience (SD = 4.067). A total of 96.4% of participants reported teaching classes with an average of 20 students, including a mean of 2.29 students with disabilities per class (SD = 0.713). Moreover, 60.7% of respondents were subject teachers, while 39.3% were special education teachers. An additional descriptive variable concerned training in educational technologies: results indicated that 78.6% (n = 22) of participants had received specific training in digital and educational technologies, whereas 21.4% (n = 6) reported they had not. All demographic characteristics of the sample are presented in Table 1 (Participants' characteristics) and Table 2 (Descriptive statistics of participants).

Table 1. Participants' Characteristics.

Characteristics		%	n
Gender	Female	82,1%	23
	Male	17,9%	5
Average number of students in class	16-20 students	96,4%	27
	21-25 students	3,6%	1
Type of teaching	Subject	60,7%	17
	Support	39,3%	11
Ad hoc training on educational technologies	Yes	78,6%	22
	No	21,4%	6

Table 2. Descriptive statistics of participants.

Characteristics	M	SD
Age	42,79	8,275
Years of teaching	9,39	4,067
Number of students with disabilities in class	2,29	0,713

7. Instruments

Data were collected through a self-report questionnaire administered via the Google Forms platform. Participants accessed the survey through a dedicated link shared in a school circular distributed by the Headmistress. The questionnaire included a socio-demographic section and the following measurement scales:

1. Intrapersonal Technology Integration Scale (ITIS) – Italian version by Benigno, Chifari & Chiorri (2014). This self-assessment instrument consists of 21 items designed to assess the core factors of the Social Cognitive Career Theory, organised into four subscales: Self-efficacy (6 items), Outcome expectations (9 items), and Interest (6 items). Participants expressed their degree of agreement on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree);

2. Multidimensional Work Motivation Scale (MWMS) – Italian version by Battistelli, Galletta, Odoardi, Núñez & Ntalianis (2017). This scale, based on Deci and Ryan's Self-Determination Theory (2000, 2012, 2016), consists of 19 items measuring different types of work motivation, distributed across six subscales: Intrinsic motivation (3 items), Integrated regulation (3 items), Identified regulation (3 items), Introjected regulation (3 items), External regulation (4 items), and Amotivation (3 items). Participants indicated the extent to which each statement applied to them, reflecting the reasons underlying their mental and physical engagement at work, using a seven-point Likert scale ranging from 1 (not at all for this reason) to 7 (exactly for this reason);

3. ad hoc Questionnaire on Teachers' Perceptions and Attitudes toward the Effectiveness of Virtual Reality in Education. This instrument was developed to assess teachers' perceptions of the ease of use and usefulness of VR in teaching. It comprised 16 items, rated on a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). In addition, one open-ended question – "In your opinion, what is the value of Virtual Reality in terms of inclusion?" – was included to gather qualitative insights into teachers' views on the inclusive potential of VR in education.

Consequently, the data analysis required the combination of quantitative and qualitative methods, integrating statistical examination with interpretative evaluation of the open responses.

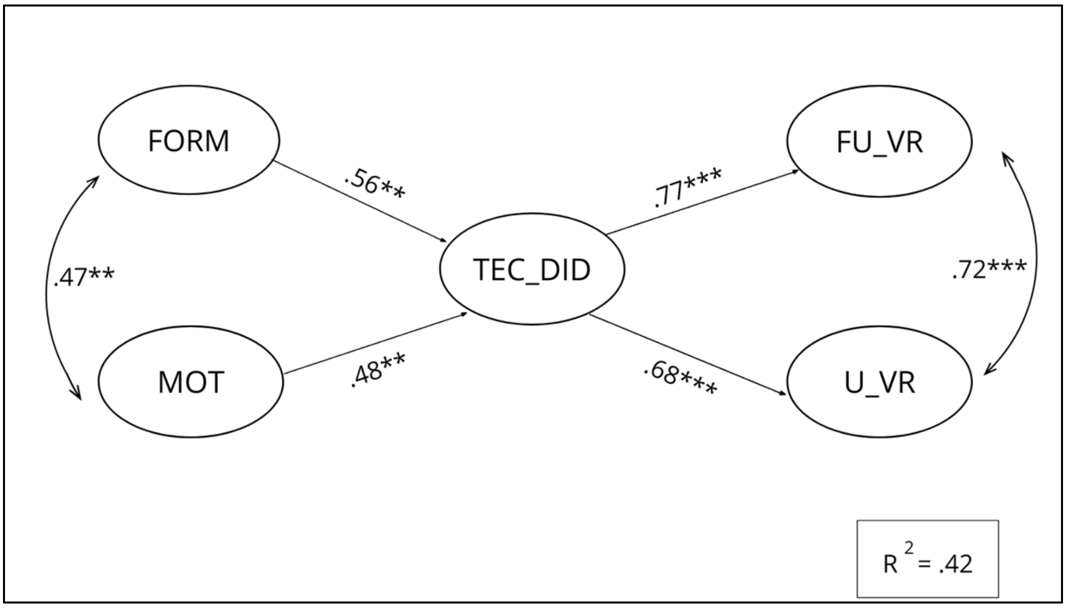
8. Results and discussion of data

8.1. Quantitative data

The collected data were analysed using SPSS software (version 26). Following the computation of frequencies and mean values for socio-demographic and measurement variables, a single mediation model was tested using linear regression analysis in order to examine the presence of both direct and mediated relationships among the study variables. The model included two predictors (FORM and MOT) and two outcomes (FU_VR and U_VR).

The regression analysis yielded an $R^2 = .42$, indicating that the model explained 42% of the variance in the data. Results showed that FORM was positively and directly related to TEC_DID ($\beta = .56$, $p < .01$), and that MOT also had a positive direct relationship with TEC_DID ($\beta = .48$, $p < .01$). In turn, TEC_DID was positively associated with both FU_VR ($\beta = .77$, $p < .001$) and U_VR ($\beta = .68$, $p < .001$). Moreover, a positive association was found between FORM and MOT ($\beta = .47$, $p < .01$), as well as between FU_VR and U_VR ($\beta = .72$, $p < .001$) (figure 2).

Figure 2. The resulting model.
Note: *p < .05; **p < 0.1; ***p < .001
FORM=Training; MOT= Motivation; TEC_DID = Educational Technologies; FU_VR = Ease of use of VR; U_VR = Usefulness of VR. All paths in the figure assume a positive relationship among the variables



The results therefore highlight a significant correlation between motivation and training, indicating that as teachers' level of digital training increases, their motivation also tends to rise; likewise, higher motivation corresponds to a greater propensity to pursue digital training. This positive reciprocal relationship leads to an increased use of digital technologies in the classroom. In turn, a significant increase in the use of educational technologies corresponds to a greater perceived ease of use and usefulness of VR. Furthermore, a significant positive correlation was found between the perceived ease of use and the perceived usefulness of VR, showing that as one increases, the other also tends to rise – and vice versa.

9. Conclusion and research limitations

The present study is not without limitations, which should be taken into account for a more comprehensive interpretation of the results and to outline future research directions. One of the main limitations concerns the sample size, which was relatively small and may have affected the generalizability of the findings. This limitation is linked to the specific context in which the research was conducted: the sample was selected through convenience sampling among teachers working in what currently represents the only school in the Apulia region equipped with a fully immersive classroom. The scarcity of similar infrastructures in the area made this choice unavoidable, as most other schools only have semi-immersive environments, such as classrooms with interactive whiteboards, digital screens, or 3D projectors, which do not allow for didactic experiences using 360-degree head-mounted displays. Moreover, although some schools are in possession of VR headsets, these are not always accompanied by dedicated classrooms nor used on a daily basis. Another limitation concerns the potential effect of social desirability on participants' responses. Although anonymity was guaranteed, it is possible that teachers sought to present themselves as professional, competent, and self-confident. This tendency may also have been influenced by the school principal's strong advocacy for technological and inclusive innovation, and her particular attention to the educational use of virtual reality as an instructional tool. Despite these limitations, the study produced significant results, supported by statistical analysis using a mediation model based on regression. Findings revealed a significant correlation between teachers' training and their motivation: as professional training opportunities increase, so too does teachers' motivation. This positive feedback loop translates into a greater use of digital technologies in the classroom, which in turn enhances the perception of both the ease of use and the usefulness of virtual reality. The positive correlation between perceived ease of use and perceived usefulness suggests that growing familiarity with these technologies may foster their more effective integration into teaching practices. Looking ahead, it will be essential to expand the research sample to include a larger number of teachers from various educational settings, ideally extending to other Italian regions or even international contexts. Furthermore, to fully understand the impact of virtual reality on inclusion, future research should directly involve students, complementing teachers' perspectives with first-hand experiences. This step is crucial, as beginning with teachers represented an essential first stage: they act as the primary mediators in the introduction of new technologies into the classroom. A thorough understanding of their perceptions and competencies is therefore fundamental for developing targeted educational interventions aimed at students. Finally, future investigations could explore the effectiveness of virtual reality not only in terms of inclusion but also as a means to foster social and emotional skills, promote empathy, and reduce cultural and linguistic barriers. Investment in technological infrastructures and specific training programs for teachers will be key to overcoming current limitations and promoting a broader integration of virtual reality within Italian schools.

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