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Teacher and Education Leader Perceptions of Digital Competences and Barriers to Digital Transformation of Education

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Abstract

Digital transformation is reshaping teaching and learning worldwide, yet its benefits remain unevenly distributed and the competences it demands of educators are still contested. This article asks how different educational stakeholders conceptualise the competences required for effective digitalisation of teaching and learning, and what they identify as the principal obstacles to it. The study forms part of an international Erasmus+ Teacher Academy project using a shared interview protocol across partner countries; this article reports the Latvian data. Thirty-two participants - pre-service teachers, in-service teachers and educational leaders, took part in semi-structured interviews, analysed using reflexive thematic analysis.

Four findings stand out. First, the competences participants named varied systematically with their position in the system: pre-service teachers emphasised operational skills, in-service teachers pedagogical integration, and leaders strategic change management; strikingly few future-oriented competences were technological. Second, language operated as a double constraint, with English proficiency governing access to tools and professional learning while a scarcity of high-quality Latvian-language resources limited classroom use. Third, artificial intelligence was experienced primarily as a challenge to assessment rather than to teaching. Fourth, barriers internal to teachers fear of error and a perceived generational divide, persisted even in well-resourced schools, and change was carried largely by early-adopting colleagues rather than institutional mandate.

Together these findings indicate that investment in equipment alone will not deliver digital transformation, and that professional development, resource policy and assessment design need to be addressed as a single problem rather than three separate ones.

Introduction

The late 20th century witnessed a technological revolution that profoundly impacted education. The advent of computers, the internet, and digital tools revolutionized how education was delivered and accessed. This era saw the maturation of technology education as a distinct field, with a focus on integrating technology into teaching and learning processes (Ritz, 2025; Dakich, 2014). Various philosophers and theorists have explored the relationship between technology and education. For instance, the Frankfurt School philosopher Andrew Feenberg has discussed the role of technology in education and its implications for democracy and pedagogy (Jandrić, 2017). The 21st century has been characterized by the widespread adoption of digital technologies in education. Online learning platforms, virtual classrooms, and educational technologies like adaptive learning systems and Artificial Intelligence (AI) have become integral to modern education. These tools have enhanced accessibility, engagement, and personalized learning experiences (Verma, 2024; Didmanidze et al., 2023). Digital technologies have the potential to improve learning outcomes by making systems work better for students, teachers, and decision-makers (Stuart et al., 2021; Perkins & Wieman, 2008). To ensure that students experience technology-enhanced learning that supports the development of higher-level

thinking skills such as critical thinking, problem-solving, and analytical reasoning and prepares them for future innovations, the focus should be on enhancing teachers' digital pedagogical competence to effectively instruct students in the 21st-century learning environment (Wohlfart & Wagner, 2023; Nussbaum et al., 2021).

The importance of digitalisation in education lies not merely in the integration of new tools, but in its transformative potential to redefine how knowledge is created, accessed, and validated. In the age of artificial intelligence and rapidly evolving information ecosystems, education is no longer centred on knowledge transmission but on the ability to critically navigate, interpret, and co-create knowledge. Digitalisation therefore becomes essential not as a technological upgrade, but as a shift in epistemological and pedagogical paradigms, requiring educators to move from content delivery to facilitating adaptive, critical, and future-oriented learning processes. At the same time, this optimistic framing warrants critical scrutiny. Critical scholarship cautions that claims about the transformative power of digital technology often outrun the evidence, and that technology tends to reproduce, rather than dissolve, existing patterns of educational advantage unless it is deliberately deployed otherwise (Selwyn, 2016).

Research question - How does position within the education system shape the way stakeholders understand the digitalisation of teaching and learning?

RQ1. What do pre-service teachers, in-service teachers and educational leaders each identify as the competences required for digitalising teaching and learning?
RQ2. What does each group count as leading digital change, and where do they locate the obstacles to it?
RQ3. How does each group understand the way decisions about technology and professional development are made, and what would they change?

Theoretical framework and literature review

Technology-enhanced learning

The case for digitalising education is usually made through a set of recurring claims about what technology makes possible. Digital tools are said to widen access by removing geographical barriers, with online platforms and virtual classrooms extending provision to learners who could not otherwise reach it; to raise engagement by supporting varied and interactive forms of activity; and to make educational processes more efficient for teachers and students alike (Verma, 2024; Didmanidze et al., 2023; Estes et al., 2017). To these are added claims about inclusion, in that technology is held to open education to learners from underserved communities; about institutional competitiveness, in that adopting digital tools is treated as a condition of remaining viable; and about a shift towards student-centred learning, in which e-learning environments complement rather than replace classroom teaching (Stuart et al., 2021; Perkins & Wieman, 2008).

Each of these claims is conditional rather than automatic, and the conditions are frequently not met. Access widens only where connectivity and devices are already in place; where they are not, digitalisation redistributes disadvantage rather than removing it, and in Latvia access to well-resourced provision remains spatially uneven (Hazans et al., 2025; Abou Karroum & Elshaiekh, 2023). Engagement does not follow from the presence of tools: the effect of technology-enhanced learning on cognitive outcomes depends on which learning activity the technology supports, so comparable tools produce markedly different results depending on how they are used (Sailer et al., 2024). Claims about efficiency are complicated by the observation that integrating technology adds preparation time and demands new competences before it saves any (Georgopoulou et al., 2024; Wohlfart & Wagner, 2023).

The inclusion claim requires the strongest qualification. Technology does not by itself reach underserved communities; without deliberate design it tends to reproduce existing patterns of educational advantage (Selwyn, 2016), and evidence from low-income school contexts indicates that digitalisation policies generate new inequalities where the needs of disadvantaged settings are not built into them (Castaño-Muñoz et al., 2025; Nzuza, 2025). The competitiveness claim, meanwhile, is an institutional rather than a pedagogical argument: adopting technology in order to remain competitive does not entail using it in ways that support learning. Finally, the shift towards student-centred practice is uneven in ways that are not always visible to those implementing it, as teachers' accounts of how digital tools are used in their classrooms diverge substantially from what students report experiencing (Frolovičeva & Daniela, 2025).

These qualifications are not an argument against digitalisation but a specification of what it requires: infrastructure distributed equitably, teachers able to design activity rather than only operate tools, and institutional decisions that follow pedagogical rather than procurement logic. The present study examines how far these conditions are met in Latvian schools, and how the stakeholders responsible for meeting them understand what is needed.

The integration of digital infrastructure into educational settings has significant implications for the implementation and effectiveness of technology-enhanced learning (TEL). TEL programs that support specific learning activities and cognitive processes, such as scaffolding and feedback, can significantly improve cognitive learning outcomes, but at the same time educators should understand principles of TEL, to avoid risks like fragmented knowledge construction, reduced ability to analyse different aspects of information, the risk that students may outsource their cognitive development to artificial intelligence, thereby limiting the formation of essential thinking skills. This suggests that the effectiveness of TEL is mediated by the type of learning activities facilitated by technology (Sailer et al., 2024) and teachers who are experts in TEL.

The effective implementation of technology-enhanced learning requires a comprehensive approach that extends beyond the mere availability of digital tools. It involves the interaction of infrastructural, pedagogical, and organisational factors, which together shape the success of digitalisation in education. These dimensions can be meaningfully understood through the DigCompEdu framework, developed by the European Commission (Redecker, 2017), which provides a structured perspective on educators’

digital competence, and which complements both the citizens' framework DigComp 2.2 (Vuorikari et al., 2022) and the widely used TPACK model of technological pedagogical content knowledge (Mishra & Koehler, 2006). At the most fundamental level, technological provision and infrastructure form the basis for any attempt to integrate digital technologies into education. Access to reliable devices, stable internet connectivity, and appropriate digital platforms is essential for enabling meaningful learning experiences. However, the reality across educational contexts often reveals significant disparities, commonly referred to as the digital divide. These inequalities not only limit access to technology but also restrict students' opportunities to develop their own digital competences. In this sense, infrastructure is not merely a technical issue but a matter of educational equity and inclusion. Equally important is teachers' readiness and attitudes toward technology. Even in well-equipped environments, the integration of digital tools depends heavily on teachers' willingness to adopt new practices and engage in continuous professional development. Within the DigCompEdu framework, this is reflected in the area of Professional Engagement, which emphasises reflective practice, collaboration, and openness to innovation. Teachers who perceive technology as meaningful and supportive are more likely to integrate it effectively, whereas resistance, uncertainty, or lack of confidence can significantly hinder its use. In addition to attitudes, teachers' digital competence plays a crucial role. This includes not only basic technical skills but also the ability to select, adapt, and critically evaluate digital resources. The DigCompEdu area of Digital Resources highlights the importance of these competences, as educators must be able to navigate an increasingly complex digital landscape. The effective use of technology requires an understanding of which tools are appropriate in specific contexts and how they can support learning objectives. However, technical proficiency alone is insufficient. The concept of digital pedagogical competence is central to ensuring that technology is used in a meaningful and purposeful way. This aligns with the Teaching and Learning and Assessment areas of DigCompEdu, where the focus is placed on designing engaging, student-centred learning experiences. Teachers must be able to integrate technology in ways that promote collaboration, critical thinking, and active participation, rather than using it as a superficial addition to traditional teaching methods. In this regard, technology becomes a means of enhancing pedagogy rather than an end in itself. Finally, the role of leadership in driving digital transformation cannot be overlooked. School leaders are responsible for creating the conditions necessary for sustainable and effective integration of technology. This includes developing a shared vision, supporting teachers' professional growth, and ensuring that technological investments align with pedagogical goals. Leadership also involves fostering a supportive organisational culture in which experimentation is encouraged and collaboration is valued. A systematic review of two decades of empirical work identifies the leadership practices that most reliably support teachers' technology integration: building professional capacity, creating communities of practice, and aligning the instructional programme with the technology available (Dexter & Richardson, 2020). Through strategic planning and the effective use of resources, leaders play a key role in bridging the gap between policy and practice. Ensuring technology-enhanced learning requires a holistic approach that integrates infrastructure, teacher competence, pedagogical practice, and institutional leadership. The DigCompEdu framework provides a valuable lens for understanding these interconnected dimensions, highlighting

that successful digitalisation in education depends not only on access to technology but also on the capacity of educators and institutions to use it meaningfully and strategically.

Despite Latvia's reputation for well-equipped schools, significant disparities exist in practice. While certain schools offer extensive technological resources to support digital learning, others remain under-resourced and struggle to provide students with adequate access to digital technologies (Hazans et al., 2025). The study by Frolovičeva and Daniela (2025) proves that there is a substantial mismatch between school policies on digital device use and what actually happens in classrooms. Although schools impose restrictions and provide regulated digital infrastructure, students still frequently rely on their smartphones for learning. Data analyses show significant discrepancies between teachers' perceptions and students' reported experiences with technology use.

Systematic and ongoing training programs are essential for developing teachers' digital pedagogical skills. These programs should cover technical skills, innovative pedagogical strategies, and the effective use of digital resources (Siyam et al., 2025; Reisoğlu, 2022). In initial teacher education, the institutional strategies that most consistently predict pre-service teachers' technology competence are the modelling of technology use by teacher educators, structured opportunities for reflection, instructional design tasks and authentic experience in schools (Tondeur et al., 2018). The effectiveness of professional development programs is paramount. High-quality training that focuses on active learning and collaboration can significantly improve teachers' technology competencies and their application in classroom practices (Siyam et al., 2025; Nzuza, 2025; Annemann et al., 2025; Daniela & Zālīte-Supe, 2025; Sarva et al., 2023).

Many educators face challenges in adapting to new digital tools and integrating them effectively into their teaching practices. This is particularly evident in regions with inadequate infrastructure and limited technological support (Georgopoulou et al., 2024; Abou Karroum & Elshaiekh, 2023). Many educators struggle with inadequate infrastructure, such as low connectivity and limited access to technology, which hampers the effective use of digital tools (Abou Karroum & Elshaiekh, 2023). The complexity of new technologies can be overwhelming, especially when educators lack the necessary training and support to use these tools effectively (Stupurienė & Gülbahar, 2022). Insufficient support from educational institutions, including inadequate funding and lack of comprehensive strategies for technology integration, poses significant obstacles (Göltl et al., 2024). Such obstacles are usefully distinguished as first-order barriers, which are external to the teacher (equipment, time, funding, technical support), and second-order barriers, which are internal (beliefs about teaching, confidence, willingness to change); the two types require different interventions, and addressing the former does not automatically resolve the latter (Ertmer, 1999). Effective policy frameworks are essential for promoting equitable access to technology in education. Current policies often fall short, and there is a need for improvements that consider the voices of marginalized communities and address the specific barriers they face. By acknowledging the needs and perspectives of disadvantaged contexts, the study suggests that digitalization policies can ensure empowerment for all students and mitigate the risk of generating inequalities (Castaño-Muñoz et al., 2025).

Teachers' willingness to adopt digital practice is bound up with professional identity: the beliefs a teacher holds about who they are professionally and what counts as competent practice. Professional identity is not settled at the point of qualification but is continuously reconstructed through experience, context and interaction with colleagues and students, and it comprises multiple sub-identities that may sit uneasily together (Beijaard et al., 2004). It is also vulnerable, in that the personal and professional dimensions of teachers' lives interact and identity can be destabilised where external demands conflict with a teacher's established sense of purpose (Day et al., 2006). This bears directly on digitalisation, because introducing an unfamiliar tool asks a teacher to risk visible incompetence in front of students, and because technologies such as generative AI alter what the teacher is for. Understood in these terms, reluctance to adopt technology need not indicate a deficit of skill or motivation; it may be a defence of a professional self that the proposed change appears to threaten.

Context of the research:

This study was conducted within the Erasmus+ Teacher Academy project *Integrated Digital Educational Leadership for the Future Teaching Academy* (IDEAL Futures, Grant Agreement No. 101104194, ERASMUS-EDU-2022-PEX-TEACH-ACA), which ran from June 2023 to June 2026. The Academy brought together six partner institutions from four European countries: Mary Immaculate College (Ireland) as coordinator, together with the Limerick and Clare Education and Training Board (Ireland), Universidad Autónoma de Madrid and Fundación Siglo22 (Spain), Université Rennes 2 (France) and the University of Latvia. The consortium therefore combined teacher education institutions, a regional education and training authority and a non-governmental education foundation, giving the project access to both initial teacher education and continuing professional development in each participating system.

The project's overall aim was to develop professional development activities and a shared digital hub supporting educators to take on roles as digital educational leaders. Alongside these development activities, the partners carried out a parallel empirical study in each participating country in order to establish what stakeholders themselves identified as the competences, conditions and obstacles relevant to digitalising teaching and learning. The study used a common interview protocol of ten open questions, developed collaboratively by the partners, covering respondents' professional trajectories, their views on educational technology, their experience of leading digital change, the barriers they encountered, the competences they considered necessary now and in the future, technology investment planning, and professional development. Each partner recruited participants from three groups - pre-service teachers, in-service teachers and educational leaders, and conducted, transcribed and analysed the interviews in the national language, so that participants could respond in the language in which they work. The protocol was drafted in English and translated into each national language by the respective partner.

The comparative design allows national findings to be read against one another, but the systems involved differ substantially in scale, governance and level of digital provision, so the national datasets are analysed separately before any cross-national comparison is attempted. The present article reports

and analyses the Latvian dataset only. Latvia is of particular interest within the consortium because it combines comparatively high levels of school equipment with pronounced regional disparities in provision (Hazans et al., 2025), and because it is a small-language education system in which the availability of high-quality digital learning resources in the language of instruction cannot be assumed.

Methodology

This study employed a qualitative research design to explore the experiences and perceptions of inservice teachers, preservice teachers and educational leaders from Latvia. The primary data collection method was semi-structured interviews, which allowed for in-depth insights into the personal narratives and professional challenges faced by the participants. The sample comprised 32 participants from various regions of Latvia, including pre-service teachers, in-service teachers, and educational leaders. Participants were selected purposefully to represent different institutional contexts, professional roles, and levels of experience, thereby enabling a multi-perspective analysis of digital transformation in education. Participants are identified throughout the Results by anonymised codes. The first element indicates the group: PST for pre-service teachers, IST for in-service teachers, and EL for educational leaders. The second element is a participant number assigned within each group. Where a participant had professional teaching experience at the time of interview, the code also states its length, since the interpretation of several themes depends on career stage; a quotation attributed to (IST-5, 5 years) therefore comes from the fifth in-service teacher in the sample, who had five years of teaching experience. It should be noted that the pre-service and in-service categories are not sharply separated in this sample: six of the pre-service teachers were already working in schools alongside their studies, in one case for six years, and their codes carry an experience figure accordingly. Gender is not encoded, and length of experience is the only individual characteristic disclosed, in order to limit the risk of participants becoming identifiable within a small national education system. Not all the interviewed teachers are cited in the text.

Interview Organization

Interviews were organized as follows:

Preparation: An interview guide was developed based on the literature review, focusing on key areas such as leadership challenges, training received, and support systems. This guide served to maintain consistency across interviews while allowing flexibility in discussions.

Scheduling: Interviews were scheduled at the convenience of the participants. Prior to each interview, participants were given an overview of the study's purpose and the confidentiality measures in place.

Conducting Interviews: Each interview was conducted via video conferencing software to accommodate the geographical dispersion of participants. Interviews lasted approximately 60 minutes and were audio-recorded with the participants' consent. Interviews were conducted in Latvian; excerpts presented in this

article were translated into English by the authors, and the translations were back-checked against the original transcripts to preserve the participants' meaning.

Post-Interview: Following each session, summary notes were made, and participants were asked to provide feedback on their experience to ensure accuracy and comprehensiveness of the information recorded. They were also informed about follow-up procedures and how they could obtain the results of the study.

Data Analysis

Audio recordings were transcribed verbatim. The transcripts were then analysed following the six phases of reflexive thematic analysis (Braun & Clarke, 2006): familiarisation with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Coding was inductive and semantic, and was carried out independently by two members of the research team, who then compared their coding and resolved discrepancies through discussion until an agreed thematic structure was reached. Trustworthiness was addressed through investigator triangulation, the maintenance of an audit trail of coding decisions, and the use of extended participant quotations to substantiate each theme (Lincoln & Guba, 1985).

Ethical Considerations

All participants provided written informed consent, were assured of their right to withdraw from the study at any time, and were guaranteed anonymity and confidentiality in the presentation of the findings.

Results

The interview results are presented sequentially according to the questions asked during the interviews.

1. **Please tell us about your journey to your current position**

Participants described strikingly varied and often non-linear pathways through which individuals enter the education sector and progress to their current professional roles. These trajectories range from early, purpose-driven aspirations and a desire to contribute to society, to unplanned career developments and transitions from other professional fields. This diversity reflects the complex and multifaceted nature of career formation within education.

One prominent pathway identified in the data is the **unplanned or incidental entry into the profession**. A considerable number of respondents report that their initial engagement with teaching or educational leadership was not a deliberate career choice but rather the result of situational opportunities or external invitations. As one respondent noted, "the path to this position was not consciously chosen" (EL-1, 18 years), while another admitted that they "ended up in the teaching position by chance." (IST-3, 3 years). In several cases, entry into the profession occurred through unexpected opportunities, such as being invited to work at a school shortly before the beginning of an academic year. Similarly, leadership roles

often emerged gradually, with one participant explaining that becoming a school principal “was not an intentional goal” (EL-2, 9 years), but rather a progression from teaching to a vice-principal position and eventually to the principalship. Entry into the profession, on this evidence, remains porous: it can be reached from outside the sector and without a prior plan to teach.

In contrast, a second pathway reflects a **strong sense of vocation and early professional identity formation**. For some individuals, the desire to become a teacher originates in childhood or during their own schooling experiences. Respondents frequently referred to an intrinsic motivation and affinity for working with children, as illustrated by statements such as “since childhood, I wanted to become a teacher; I have always liked children” (PST-8) and “already in early school years, I felt a calling and the ability to become a teacher” (PST-6). Inspirational teachers and early experiences of helping peers also played a significant role in shaping these career choices. For example, one participant highlighted that during school years, they realised their teaching abilities by “helping classmates and understanding that they had the skills to teach and support others” (PST-1, 2 years). This pathway aligns with traditional notions of teaching as a vocation grounded in personal values and intrinsic motivation.

A third pattern evident in the data is **career transition from other professional fields or entry through alternative pathways**. Several respondents entered education after initial careers in unrelated sectors, including information technology, food technology, or the arts. These transitions were often facilitated by structured programmes or by a gradual reorientation of professional interests. For instance, one respondent described completing a degree in IT project management and working in the field before joining an alternative teacher training programme, through which they “entered and remained in the school system” (IST-2, 7 years). Others reported shifting from professions such as accounting or visual arts, with teaching emerging as a new professional direction during their studies. This pathway highlights the permeability of the education sector and its capacity to attract individuals with diverse professional backgrounds.

A further theme concerns **pragmatic motivations, including the search for stability and social contribution**. Some respondents described their decision to enter education as a rational choice, motivated by job security and the perceived societal value of the profession. For example, one participant explained that they chose the field of education because it “ensured stable employment opportunities” (PST-2, 1 year), while another emphasised the desire to work in a field “that provides added value and benefits society” (PST-6). The teaching profession was also associated with stability and long-term security, which remains a significant factor in career decision-making.

Finally, the data reveal a pathway characterised by **intentional career development driven by innovation and personal vision**, particularly among more experienced education professionals and leaders. These individuals often describe a proactive approach to shaping the education system, guided by a desire to implement change and develop new models of practice. One respondent articulated an ambition to “build my own school that would serve as a lighthouse for other institutions and allow experimentation with different teaching methods” (EL-3, 6 years). Similarly, leadership roles in areas such as educational

technology were seen as a logical progression based on both expertise and motivation, as one participant noted that becoming a head of an IT department was “a natural outcome, given both the knowledge of educational processes and the desire to take on this role” (EL-5, 10 years).

The findings demonstrate that career pathways into education are highly heterogeneous, encompassing both planned and emergent trajectories. This diversity suggests that the education sector benefits from a wide range of motivations, experiences, and professional identities. At the same time, it raises important questions about how teacher education, recruitment, and professional development systems can better support individuals entering the field through different pathways.

The heterogeneity of these entry routes matters for what follows. Because participants arrived at their present roles by such different paths - some through early vocation, some by accident, some after a first career in another sector, the differences reported between the three groups in the sections below cannot be read as stages in a single shared trajectory.

2. **What are your views on technologies in education and the digital challenges that the education sector will face in the future?**

The perspectives of education professionals and pre-service teachers suggest that while technology is widely perceived as an inevitable component of contemporary education, its integration remains complex and multifaceted. Respondents consistently emphasise that the value of technology lies not in its mere presence but in its pedagogically meaningful application. This highlights an important shift from technology adoption towards purposeful and reflective use.

A central theme emerging from the data is the need to ensure that technology serves as a supportive pedagogical tool rather than a substitute for the teacher. Respondents stress that “technologies should support the teacher, not replace them” (PST-4, 6 years), warning that otherwise “the meaning of interaction may be lost” (PST-4, 6 years). This reflects broader concerns about preserving the relational and communicative dimensions of teaching. At the same time, participants underline the importance of intentionality, pointing out the need for a “clear understanding of the purpose of technology use and the intended outcomes” (IST-7, 2 years), and cautioning that technologies “should not be introduced as an end in themselves” (IST-3, 3 years).

Another significant challenge relates to teacher preparedness and the so-called “generation gap” (EL-1, 18 years). The findings indicate substantial disparities in digital competence and confidence, particularly between younger and more experienced educators. Respondents describe “a huge barrier in technology use between younger and older teachers” (EL-1, 18 years) and highlight that fear of failure often limits engagement, as “teachers are often afraid of making mistakes” (EL-4, 20 years). This suggests that professional development needs to address not only technical skills but also attitudes, self-efficacy, and support mechanisms for teachers at different career stages.

Concerns about the impact of technology on students' learning behaviours also emerge prominently. Respondents identify risks related to overreliance on digital tools, noting that students may become "overly dependent on the possibilities offered by technologies" (PST-5, 1 year) and less inclined to make independent decisions. In addition, there is evidence of perceived declines in fundamental skills, such as handwriting and fine motor abilities, with participants expressing concern that "students have poor handwriting quality" (IST-9) and "reduced ability to write by hand" (IST-6, 6 years). These observations point to the need for a more balanced integration of digital and traditional learning practices.

Artificial intelligence (AI) is highlighted as a particularly transformative yet challenging development. While respondents acknowledge that "artificial intelligence should be integrated into the learning process" (IST-3, 3 years), they also stress that this must be done "wisely." The data reveal emerging tensions in the perceived value of learning itself, as students question "why learn if artificial intelligence can provide the answer" (IST-3, 3 years). At the same time, concerns are raised about academic integrity and assessment practices, with respondents noting that students have become adept at using AI in tasks such as essays and tests. This underscores the need to rethink pedagogical approaches and assessment design in the context of AI.

Structural constraints further complicate technology integration. Respondents point to significant inequalities in access, particularly in rural areas, where "access to technologies is insufficient" (PST-5, 1 year). In addition, the lack of high-quality digital resources in the Latvian language is described as a "critical" issue. Challenges related to infrastructure, maintenance, and funding are also evident, as schools often lack the resources necessary for "updating and maintaining technologies" (EL-5, 10 years). These findings highlight that effective technology integration is not only a pedagogical issue but also a systemic one.

Finally, the importance of maintaining a balance between digital and real-world learning experiences is strongly emphasised. Respondents argue for a "golden balance between technologies and traditional methods" (IST-6, 6 years) and stress that education should not lose its focus on human interaction and experiential learning. Concerns about diminishing face-to-face communication, where "the value of direct interaction is decreasing" (PST-2, 1 year), further reinforce the need for a holistic approach to educational innovation.

Overall, the findings suggest that the integration of technology in education requires a careful balance between innovation and pedagogy, technical advancement and human interaction, as well as access and equity. While the potential of digital tools and AI is widely recognised, their effective use depends on thoughtful implementation, teacher preparedness, and a sustained focus on learners' developmental needs.

Pre-service teachers and students adopt a critical yet balanced view, acknowledging the benefits of technology while emphasising risks related to health, skill degradation, and social inequality. They highlight concerns about unequal access, language barriers, and the potential negative impact of artificial intelligence on students' cognitive development and independence.

Practicing teachers approach technology from a pragmatic perspective, focusing on its impact on workload, teaching quality, and classroom practices. They underline the lack of time and high-quality resources, as well as the risk of superficial technology use without pedagogical purpose. The emergence of AI is seen as both supportive and challenging, requiring teachers to take on new roles in ensuring academic integrity and maintaining student engagement.

School leaders adopt a strategic and systemic perspective, emphasising organisational efficiency, sustainability, and the management of change. Their concerns centre on resource allocation, infrastructure maintenance, and overcoming staff resistance, while also highlighting the importance of balancing technological innovation with human interaction and critical thinking.

These findings suggest that the integration of technology in education involves interconnected pedagogical, organisational, and societal challenges, requiring balanced and context-sensitive approaches across all levels of the education system.

3. What is your experience in leading digital transformation and/or innovation in schools, educational institutions, or the education sector?

The experiences of educational professionals in leading digital transformation reveal a broad spectrum of practices, ranging from the digitalisation of administrative processes to the implementation of innovative pedagogical initiatives and professional development activities. The findings suggest that digital transformation in education is not a linear or centrally driven process; rather, it often emerges from local needs, individual initiative, and situational pressures, particularly in response to crisis contexts such as the COVID-19 pandemic.

One of the most prominent areas of engagement concerns the digitalisation of administrative processes and communication systems. School leaders frequently emphasise the role of technology in structuring institutional workflows, managing data, and facilitating communication. As one respondent noted, “technologies help in managing large schools – organising school systems, online document circulation, and data analysis” (EL-1, 18 years). Similarly, digital ecosystems such as Google Workspace are widely used to support daily operations, including “document management and interdisciplinary lesson planning” (EL-3, 6 years). Communication practices have also been transformed, with institutions establishing dedicated digital channels that “ensure information flow alongside face-to-face meetings” (EL-6). These findings indicate that administrative digitalisation often serves as an entry point for broader institutional transformation.

A second key dimension is the implementation of learning platforms and the development of digital strategies. Respondents describe both the adoption of established platforms and the creation of institution-specific digital environments. For instance, one school “implemented Moodle several years ago for storing learning materials and organising the learning environment” (EL-2, 9 years). More strategic approaches have also emerged, particularly during the pandemic, when institutions were compelled to rethink their digital readiness. One participant described initiating a project “to develop a

school digital strategy in order to understand the existing situation and create a digital environment and materials for vocational education programmes" (EL-7). In early education contexts, innovation extends to the creation of dedicated spaces, such as a "children's computer classroom equipped with an interactive whiteboard and educational robots" (EL-6). These examples highlight the increasing importance of strategic planning in digital transformation.

Another critical aspect of digital leadership involves capacity building through peer learning, training, and mentoring. Many respondents identify themselves not only as users of technology but also as facilitators of change within their institutions. Regular professional development activities are organised, with one participant noting that they "conduct sessions for colleagues every year before the start of the school year on various digital tools" (IST-3, 3 years). In several cases, early adopters of technology played a pivotal role during the pandemic by experimenting with new tools and subsequently training others. For example, one respondent reported that they were among the first to introduce MS Teams in their school, having first explored it independently and later "trained colleagues" (IST-3, 3 years). Similarly, collaborative working groups have been used to support knowledge sharing, where teachers "learned to use various Google tools" (IST-9). These findings underscore the importance of distributed leadership and peer support in overcoming resistance to technological change.

In addition to organisational and pedagogical support roles, some professionals actively contribute to the development of new curricular directions and innovative educational practices. Respondents describe involvement in designing new programmes and digital learning resources, particularly in emerging fields such as robotics and digital design. For example, one participant highlighted their role in "introducing a robotics strand where students learn programming, robotics, and digital design" (IST-2, 7 years). Others have developed subject-specific digital materials, such as "digital learning resources in design and technology" (EL-4, 20 years). Innovation is also evident in initiatives aimed at improving student well-being, including digital monitoring tools. One example is the implementation of a preventive programme in early childhood education, where "staff complete electronic questionnaires to identify potential issues in a timely manner" (EL-1, 18 years). These activities illustrate how digital transformation extends beyond technology adoption to encompass broader pedagogical and organisational innovation.

The data also demonstrate the use of innovative digital approaches to strengthen community engagement and student participation. Technologies are employed not only for instructional purposes but also to create meaningful connections between schools, students, and families. For instance, one school developed a "Christmas story in video format, where each group created and filmed performances" (EL-6), representing "a new and innovative way of combining digital technologies with real-life experiences" (EL-6). Interactive tools such as online quizzes (e.g., Kahoot) are also used to enhance engagement, while digital platforms like EMU: School are valued for their ability to "monitor and assess the emotional climate at both classroom and school levels" (IST-11). These examples demonstrate the potential of digital tools to support more inclusive and participatory educational environments.

The findings highlight that digital transformation in education is a multifaceted process shaped by a combination of structural, pedagogical, and individual factors. While institutional strategies and technological infrastructures play an important role, individual agency, particularly in initiating, adapting, and disseminating innovations, emerges as a central driver of change.

4. What is your experience in leading digital learning to ensure that every participant is engaged?

The interview data reveal that educational professionals and pre-service teachers employ a wide range of strategies to ensure the engagement of all participants in digital learning environments, including students, parents, and colleagues. These strategies are not solely technology-driven; rather, they are grounded in relational, pedagogical, and contextual considerations. A recurring theme across the data is that meaningful engagement depends on emotional connection, personalised support, and the purposeful selection of digital tools adapted to diverse needs.

One of the most prominent dimensions is the emphasis on **emotional connection and individualised approaches**. Respondents consistently highlight that technology itself does not guarantee engagement; instead, it is the teacher's ability to understand learners and provide appropriate support that plays a decisive role. As one participant explained, "it is very important to personally know your students and build an emotional connection" (PST-9), noting that this enables teachers to anticipate which students will require additional support. The process of adopting digital tools is also framed as a shared learning experience, where psychological safety is essential. For example, respondents stress the importance of creating a supportive environment in which "we try and learn together, and making mistakes is acceptable" (EL-3, 6 years). This approach extends to colleagues as well, with particular attention given to those who may feel less confident, as "more hesitant colleagues require an individual approach, taking into account psychological aspects" (EL-2, 9 years). These insights suggest that inclusive digital learning is closely tied to relational pedagogy and trust-building.

A second key aspect involves the **use of digital technologies to enhance inclusion and accessibility**. Digital tools are actively employed to reduce barriers to participation and to accommodate diverse learner needs, including those related to special educational needs or socio-economic differences. For instance, assessments are often designed in digital formats to provide flexibility: "tests are created in a digital format so they can be completed at home, with options to enlarge the font or allow more time." Assistive technologies also play a significant role, such as text-to-speech tools that "scan and read the text to the student" (IST-7, 2 years), thereby reducing the need for individual teacher explanations and supporting independent learning. Additionally, digital platforms contribute to emotional well-being, as one respondent noted that using tools like Google Classroom "reduces student anxiety, as they know the teacher is present and they do not have to compete for attention" (PST-3). These practices demonstrate how technology can be leveraged to create more inclusive and supportive learning environments.

Another important dimension is the **organisation of dynamic and varied learning processes**. Respondents emphasise that maintaining engagement requires diversity in instructional methods and continuous interaction. Traditional, teacher-centred approaches are supplemented with collaborative and

interactive activities, including group work, digital assessments, and rotating task structures. One participant highlighted the importance of “variety and dynamics in the lesson, not just a monotonous teacher explanation but also activities such as group work and tests” (PST-10). Rotational learning strategies are also used, where “students work in smaller teams and move between tasks” (EL-5, 10 years), ensuring that all learners actively participate. Furthermore, the integration of breaks, feedback activities, and opportunities for expression is seen as essential for sustaining attention, as “it is important to include breaks, check knowledge through tasks, and allow students to express their opinions and share experiences” (IST-8). These findings point to the importance of pedagogical design in fostering engagement in digital contexts.

The data also underscore the role of **parental and community involvement** in supporting inclusive digital learning. Digital communication tools are used to increase transparency and strengthen connections between schools and families. For example, the creation of institutional social media platforms allows schools to share “photo and video materials with parents,” enabling them to feel more informed and involved. Respondents also note that digital technologies “make the learning process more transparent, allowing not only students but also parents and school leadership to follow what is happening in lessons” (PST-7, 4 years). In addition, feedback mechanisms such as anonymous surveys ensure that all stakeholders can participate, as “everyone involved in the educational process can express their opinion anonymously” (IST-11). This highlights the role of digital tools in fostering a more participatory and collaborative educational ecosystem.

An additional theme relates to the **provision of equal access to technological resources**, which is identified as a prerequisite for meaningful engagement. Respondents acknowledge that without adequate infrastructure, inclusive digital learning cannot be achieved. Schools therefore seek to provide on-site access to devices to mitigate inequalities arising from students’ home environments. As one participant noted, ensuring access to personal computers in school is “very positive, as it guarantees equal opportunities for all students, including those who do not have access to a computer or internet at home.” In some cases, this consideration also influences pedagogical decisions, such as avoiding digital homework assignments due to disparities in home resources. Another respondent emphasised that “students must be given the opportunity to work with a computer at school, taking into account their home conditions and social situation” (PST-4, 6 years). These findings highlight the structural dimension of inclusion and the importance of equitable resource distribution.

The evidence suggests that ensuring engagement in digital learning environments requires an integrated approach that combines pedagogical sensitivity, technological flexibility, and organisational support. Engagement is achieved not through technology alone but through its thoughtful integration into a broader framework of inclusive educational practices.

5. What challenges or limitations do education professionals (leaders, administrators, and teachers) face in integrating digital technologies in schools?

Educational professionals, including school leaders and teachers, identify a wide range of challenges that hinder the effective integration of digital technologies in educational settings. These challenges span structural, organisational, and individual dimensions, indicating that digital transformation is constrained not only by access to resources but also by human and systemic factors.

A fundamental barrier relates to **insufficient infrastructure and unequal access to technological resources**. Respondents consistently highlight disparities between urban and rural contexts, where access to reliable internet and adequate devices remains limited. As one participant noted, “access to technologies is insufficient in rural schools” (PST-2, 1 year), while another emphasised that the COVID-19 pandemic exposed significant vulnerabilities, particularly in areas with “poor internet coverage, making digital work difficult” (EL-3, 6 years). Even within schools, resources are often limited, requiring careful planning and sharing: “technical equipment is not sufficient for all (e.g., 30 tablets for all students), so usage must be scheduled.” Financial constraints further exacerbate these issues, especially in smaller institutions, where “limited financial resources” (IST-7, 2 years) and even “negative attitudes towards investing in technology” (EL-3, 6 years) can restrict development. These findings underscore persistent inequalities that directly affect the feasibility of digital learning.

Another major challenge is associated with **teacher workload and time constraints**. The integration of digital technologies is not merely a technical process but requires significant time investment in lesson preparation, tool familiarisation, and pedagogical adaptation. Respondents frequently report that “there is a lack of time to prepare lessons that incorporate digital technologies” (EL-1, 18 years), highlighting the tension between innovation and existing workload demands. High levels of professional responsibility further complicate this process, as “one of the biggest problems is workload… there are too many requirements to manage daily responsibilities while also integrating innovations” (IST-5, 5 years). In addition, professional learning is often constrained by a lack of institutional support, with respondents noting that “the time spent learning new skills should be compensated” (EL-4, 20 years). These insights suggest that without structural adjustments, expectations for digital innovation may remain unrealistic.

The **human factor**, particularly resistance to change and generational differences, represents another significant barrier. Respondents frequently refer to a “generation gap” (PST-7, 4 years), describing how more experienced educators may be less inclined to adopt new technologies. For example, one participant noted that “a challenge is the unwillingness of older teachers to change” (EL-1, 18 years), while another emphasised that “teachers often find it difficult to adapt” (EL-1, 18 years). Psychological factors, including fear of failure, also play a critical role. As highlighted in the interviews, “teachers are often afraid of making mistakes, which leads them to avoid using technologies” (IST-5, 5 years), and “people tend to fear the unfamiliar” (IST-8). These findings indicate that digital transformation requires not only technical training but also targeted support addressing attitudes, confidence, and professional identity.

In addition to infrastructural and human challenges, respondents emphasise the **lack of high-quality digital content and learning materials**. The issue is particularly acute in relation to resources available in the Latvian language, where there is a "critical lack of high-quality digital materials across subject areas" (IST-11). The problem extends beyond language to include the limited availability of resources suitable for advanced technologies such as drones, virtual and augmented reality, and robotics. One respondent noted that "a major problem is the lack of learning materials that would allow the use of different technologies" (EL-5, 10 years), while another pointed out that "the availability of ready-made resources is a challenge, as not all teachers are prepared to create their own materials" (IST-2, 7 years). This highlights the need for both content development and capacity building in instructional design.

Another concern raised by respondents is the **instrumental or superficial use of technology without clear pedagogical purpose**. There is a risk that digital tools are used primarily to increase engagement or novelty rather than to support learning outcomes. As one participant explained, "a challenge is the use of technology as an end in itself… used just to make lessons more interesting, without pedagogical justification" (EL-1, 18 years). Similarly, respondents stress that technologies "should not be introduced without understanding their pedagogical added value or preparing teachers accordingly" (IST-3, 3 years). These insights reflect the importance of aligning technological integration with sound pedagogical principles.

The rapid development of **artificial intelligence (AI)** introduces additional complexities, particularly in relation to assessment and academic integrity. Respondents highlight the growing difficulty of ensuring authentic student work, noting that "students have learned to use AI effectively in tests and essays" (IST-7, 2 years), which creates challenges for teachers in designing meaningful assessment tasks. One participant described how tools such as ChatGPT have transformed the teaching role, stating that "this innovation forces teachers to become 'detectives' and changes the entire dynamic of the learning process." These findings suggest that AI is reshaping not only learning practices but also the fundamental assumptions underlying assessment.

Institutional and administrative factors further complicate digital transformation, particularly in relation to **centralised procurement and maintenance of technologies**. Respondents indicate that centrally managed purchasing systems may not adequately address the specific needs of individual schools. For example, "centralised procurement does not allow schools to receive equipment tailored to their needs" (EL-2, 9 years). In addition, ongoing maintenance and updating of technologies present continuous challenges, as "there are often insufficient financial resources for maintaining technologies and updating applications" (EL-5, 10 years). This points to the importance of flexible and context-sensitive policy approaches.

Taken together, these findings illustrate that the integration of digital technologies in education is constrained by an interplay of infrastructural limitations, workload pressures, psychological barriers, and systemic factors. Addressing these challenges requires coordinated efforts at multiple levels, including policy, institutional leadership, and professional development.

Pre-service teachers focus primarily on broader societal and developmental concerns, particularly inequalities in access to technology and the potential loss of fundamental skills due to overreliance on digital tools. They also emphasise health-related and behavioural risks, as well as the disconnect between university training and real school contexts.

Practicing teachers approach these challenges from a practical and operational perspective, with a strong emphasis on workload, time constraints, and the lack of high-quality teaching materials. They also highlight emerging challenges related to artificial intelligence, which alters assessment practices and increases professional demands, alongside persistent infrastructural limitations.

School leaders adopt a strategic and systemic viewpoint, focusing on financial sustainability, administrative constraints, and the management of human factors within the organisation. Their concerns include long-term maintenance costs, limitations of centralised decision-making, and the need to address staff resistance to change, as well as infrastructural constraints of school environments.

These findings indicate that challenges of digital integration span multiple levels, from individual and pedagogical to organisational and systemic, requiring coordinated and context-sensitive approaches to effectively support digital transformation in education.

6. What skills are needed to lead digital learning in the teaching and learning process?

The analysis of interview data indicates that leading digital learning requires a broad and multifaceted set of competences that extend beyond technical proficiency. Educational professionals emphasise that effective digital leadership involves the integration of pedagogical knowledge, critical thinking, communication skills, and specific personal attributes. This reflects the complexity of digital transformation as both a technological and a human-centred process.

A foundational requirement identified across the data is the presence of **basic digital and technical competences**. Teachers are expected to be confident users of technology in order to integrate digital tools into teaching and support others in their use. Respondents explicitly highlight the need for “digital skills of the teacher themselves” (EL-1, 18 years), including familiarity with commonly used tools such as “Word, PowerPoint, and similar applications” (PST-6). Practical competences, such as the ability to “use different devices – computers, phones” (PST-5, 1 year) and “connect hardware” (PST-4, 6 years), are also considered essential. These findings suggest that baseline digital literacy remains a prerequisite for more advanced forms of pedagogical innovation.

Beyond technical skills, respondents stress the importance of **pedagogical and didactic competence**. The integration of technology must be aligned with learning objectives and grounded in sound instructional design. Participants emphasise that teachers need “very good knowledge of lesson structure and didactics” (EL-1, 18 years), as well as the ability to evaluate “which technologies to use and at what stage of the learning process” (IST-2, 7 years). Differentiation is also highlighted as a critical skill, with teachers expected to adapt tasks and methods to diverse learners. Media literacy plays a significant

role in this context, requiring educators to “choose the appropriate tool and consider what it contributes, weighing its advantages and disadvantages” (IST-6, 6 years). These insights underline that meaningful technology integration depends on pedagogical intentionality rather than technological novelty.

Another key competence area relates to **critical thinking and information literacy**, particularly in an environment characterised by rapid technological change and the increasing presence of artificial intelligence. Respondents emphasise that teachers must possess “critical thinking” (PST-5, 1 year) skills to evaluate the quality and appropriateness of digital resources. This includes the ability to assess materials in relation to “students’ age, topic, and intended learning outcomes.” The emergence of AI-generated content introduces new challenges, as teachers are expected to “identify texts generated by artificial intelligence, such as essays in literature” (IST-1). In addition, awareness of data security and digital risks is essential, with respondents noting that teachers “must be informed and knowledgeable about risks and data protection.” These findings highlight the growing importance of critical digital literacy in contemporary education.

The importance of **foreign language competence**, particularly in English, is also strongly emphasised. Given that a large proportion of digital tools, software interfaces, and educational resources are available primarily in English, language skills are seen as enabling access to global knowledge and innovation. As one respondent explained, “most technologies… are in English, so at least basic knowledge of English is required” (PST-3). Another participant described foreign language proficiency as “a major advantage” (IST-6, 6 years), while others stressed its importance for “implementing knowledge at a global level” (EL-4, 20 years). This suggests that language competence functions as a gateway to professional development and innovation in digital education.

A further critical dimension is **self-directed learning and curiosity**, which are necessary for adapting to rapidly evolving technologies. Respondents highlight that educators must be willing and able to continuously update their knowledge independently. One participant stated that “teachers must be able to learn on their own and not be afraid to experiment and explore, rather than waiting for someone to show them” (IST-2, 7 years). Curiosity, openness to new experiences, and adaptability are repeatedly mentioned as essential attributes. The concept of “self-directed learning for both students and adults” (EL-4, 20 years) is positioned as a core principle of effective digital education, indicating a shift towards more autonomous and lifelong learning practices.

In addition to professional competences, the data emphasise the importance of **personal qualities such as flexibility, empathy, and patience**. Leading digital transformation involves working with individuals who may have varying levels of confidence and readiness for change. Respondents identify attributes such as “flexibility, communicability, diplomacy, and discipline” (IST-3, 3 years) as important for navigating complex situations. Empathy is particularly valued in mentoring contexts, where “mentors must be very understanding and empathetic” (EL-2, 9 years). Motivation, patience, and enthusiasm are also highlighted, alongside the ability to view mistakes as part of the learning process: “there must be a willingness to make mistakes and learn from them, seeing errors as a path to growth” (IST-7, 2 years).

These findings reinforce the idea that emotional and interpersonal competences are integral to successful digital leadership.

For those in leadership positions, additional emphasis is placed on **management and communication competences**. Educational leaders are expected to guide institutional change, articulate a shared vision, and support their staff through the transformation process. Respondents stress that “the ability to lead change and communicate effectively is essential for educational leaders” (IST-2, 7 years). The capacity to “visualise and verbalise the goal towards which the school is moving” (IST-3, 3 years) is seen as particularly important. Leaders are also expected to model continuous learning and innovation, as “a leader must be one step ahead, showing the way to teachers and encouraging them” (EL-3, 6 years). Persuasion skills further support the implementation of change initiatives. These findings highlight the role of leadership as a key driver of successful digital transformation in education.

The evidence suggests that leading digital learning requires an integrated competence framework that combines technical expertise, pedagogical knowledge, critical awareness, and interpersonal skills. The interplay of these competences reflects the complex and evolving nature of teaching and leadership in digitally mediated educational environments.

Pre-service teachers primarily emphasise technical agility and information literacy, focusing on the ability to independently use and troubleshoot technologies, critically evaluate digital content, and adapt flexibly to changing situations. Their perspective reflects an operational level of engagement, where maintaining functionality and effective communication with students is central.

Practicing teachers shift the focus towards pedagogical integration, underscoring the importance of aligning technology use with didactic goals. They prioritise critical evaluation of tools based on their pedagogical value, as well as continuous learning, language skills, and psychological readiness to adapt to change. This highlights a transition from technical competence to reflective and purposeful use of technology in teaching.

School leaders approach digital learning from a strategic and organisational perspective, emphasising change management, communication, and team development. Their focus lies on creating supportive environments, fostering collaboration, and using data to inform decision-making, while maintaining a forward-looking understanding of emerging technologies.

These findings illustrate a shift from operational to pedagogical and strategic competences, suggesting that effective digital learning management requires a holistic and role-sensitive approach across all levels of the education system.

7. What skills will be needed in the future to use technologies in the learning process?

The analysis of interview data suggests that in the future, effective use of technology in education will extend far beyond technical proficiency. Educational professionals emphasise that the central focus will shift towards pedagogical meaningfulness, critical thinking, and the ability to engage in continuous

learning in response to rapid technological change. This reflects a broader transformation of the teaching profession, where adaptability and reflective practice become essential components of professional competence.

A key theme emerging from the data is the growing importance of **pedagogical expertise and critical thinking**. Respondents consistently stress that technology should remain a tool serving educational objectives rather than becoming an end in itself. Teachers are therefore expected to possess strong didactic knowledge, including “very good knowledge of lesson structure and pedagogy” (EL-1, 18 years), enabling them to integrate technologies purposefully into the learning process. In the context of artificial intelligence, this competence becomes even more critical, as educators must be able to “define and adapt the content that is assessed” (EL-3, 6 years), ensuring that learning tasks remain meaningful and authentic. Critical thinking is identified as a core skill, with respondents noting that “it will be necessary to critically evaluate and adapt, accepting that technologies may replace certain functions” (IST-7, 2 years). At the same time, maintaining a balance between digital and non-digital practices is emphasised, as “the most important task will be to preserve a balanced approach between digital technologies and real-life skills” (EL-6). These insights highlight the need for a pedagogically grounded approach to technological integration.

Another significant competence area is **self-directed learning and adaptability**. Given the rapid pace of technological development, educators must continuously update their knowledge and skills independently. Respondents underline the importance of intrinsic motivation and initiative, stating that teachers “must be able to learn independently, motivate themselves, recognise the need for learning, and take responsibility for it” (IST-2, 7 years). Practical problem-solving skills are also essential, including the ability to “search for and find information on how to use tools and solve technical problems independently” (PST-9). Readiness to learn and openness to experimentation are seen as fundamental, with one participant emphasising that “teachers must be innovative and not afraid of making mistakes” (IST-5, 5 years). These findings suggest that lifelong learning is not only desirable but necessary for sustained professional relevance.

The importance of **foreign language skills and global collaboration** is also strongly emphasised. As most technological innovations and educational resources are initially available in English, language competence is viewed as a critical enabler of access to knowledge. One respondent noted the need for “awareness that an IT professional can never know everything… and therefore foreign language skills, especially English, are essential” (EL-2, 9 years). Others highlight that such skills are necessary “to implement knowledge at a global level” (EL-4, 20 years). In addition, collaboration and communication with colleagues are seen as important for effective implementation, including the “ability to discuss, communicate, and consult with colleagues on the successful use of tools” (IST-5, 5 years). These findings position language and collaboration as key components of professional competence in a globalised digital environment.

Another dimension concerns **emotional intelligence and communication skills**, which are expected to become increasingly important as digital environments expand. Respondents suggest that the role of the teacher is evolving towards that of a mentor and facilitator, requiring the ability to build meaningful relationships with students. Empathy is highlighted as a crucial attribute, as “people will increasingly live in virtual environments, requiring changes in philosophy and worldview” (IST-3, 3 years). Effective communication is also essential, including the ability to “speak the students’ language” and present content in an accessible way. The ability to “explain and communicate ideas simply, even to students” (IST-5, 5 years), is considered particularly valuable. These insights indicate that interpersonal competences will remain central to teaching, even in highly digitalised contexts.

The integration of **artificial intelligence and data-related competences** represents another important area of future development. Rather than resisting AI, respondents emphasise the need to incorporate it meaningfully into teaching and learning processes. As one participant noted, “there is no need to fear artificial intelligence; it is necessary to learn how to use it, ask the right questions, and apply it meaningfully.” Data literacy is also becoming increasingly relevant, with respondents highlighting the importance of “data collection and analysis that is effective, clear, and presentable to colleagues” (EL-1, 18 years). In addition, technical integration skills, such as the ability to “connect and integrate different digital devices” (PST-4, 6 years), remain important as part of a broader competence framework.

For educational leaders, **leadership and management competences** are identified as essential for guiding digital transformation. Leaders are expected to create supportive environments in which innovation can be implemented effectively and sustainably. Respondents emphasise that “a leader must be one step ahead, showing the way to teachers and encouraging them” (EL-3, 6 years), highlighting the importance of vision and proactive engagement. Team-building is also a critical responsibility, as school leaders must be able to “assemble a team with experts who understand how to lead digital learning” (IST-2, 7 years). These findings point to the strategic role of leadership in shaping institutional readiness for future challenges.

The data indicates that future competences for digital learning are characterised by the integration of pedagogical, cognitive, social, and technological dimensions. The shift from technical skills to holistic professional competence reflects the evolving demands placed on educators in digitally mediated learning environments.

Pre-service teachers emphasise technical independence, focusing on the ability to troubleshoot digital tools, critically evaluate information, and navigate AI-generated content. Their perspective highlights adaptability, communication skills, and the need to balance technology use in students’ daily lives.

Practicing teachers, in contrast, prioritise pedagogical integration and professional maturity. They stress critical thinking, continuous self-directed learning, and the importance of foreign language skills for accessing global resources. Additionally, they highlight the growing relevance of emotional intelligence and data security awareness in an increasingly digital learning environment.

School leaders adopt a strategic and systemic perspective, focusing on long-term development and the effective integration of technology into teaching and organisational processes. Their emphasis lies on leading change, leveraging artificial intelligence meaningfully, using data for decision-making, and fostering professional networks to support innovation.

These differences illustrate a developmental progression from technical competence to pedagogical expertise and strategic leadership, suggesting that future-oriented professional development should address all three dimensions in an integrated manner.

8. How do you and your school plan investments in technological development in schools? What difficulties have you encountered when deciding which technologies to invest in?

The responses of school leaders and teachers indicate that planning technological development in educational institutions is a complex and multi-layered process. It involves the alignment of strategic vision, data-informed decision-making, and the identification of teachers' individual needs. At the same time, this process is frequently constrained by financial, administrative, and infrastructural limitations, which shape both the scope and effectiveness of technology integration.

The planning of investments in technology typically occurs at multiple levels, combining **strategic, participatory, and opportunistic approaches**. At the institutional level, planning is often guided by long-term development strategies and supported by data analysis. As one respondent explained, planning is conducted "in accordance with the school development plan, initially collecting data and information" (EL-1, 18 years), while another emphasised that "long-term planning allows for setting budget priorities." These practices suggest an increasing awareness of the need for structured and evidence-based approaches to technological investment.

In parallel, many institutions adopt **participatory approaches that incorporate teachers' needs and perspectives**. Annual surveys and consultations are commonly used to identify priorities for both professional development and technological resources. For example, one respondent noted that "once a year, teachers are surveyed to identify needs for improving technological provision" (EL-1, 18 years), while another indicated that "teachers write down their wishes each year regarding both professional development and technological support" (EL-2, 9 years). In some cases, this process is formalised through structured input, where "each teacher lists the technologies they would like to acquire in the spring" (IST-6, 6 years). These practices reflect a bottom-up dimension in planning, where teachers are actively involved in shaping the technological environment.

At the same time, planning processes often combine **bottom-up and top-down approaches**, balancing teacher initiatives with leadership vision. Respondents highlight that "technology planning takes place in two ways… both through teachers' initiatives and through leadership's vision of what is needed" (IST-3, 3 years). School leaders play a key role in evaluating the practical applicability of technologies, as illustrated by statements referring to "the principal's vision of what is necessary for a more effective

learning process, considering real usage potential" (EL-3, 6 years). This dual approach indicates an effort to align institutional goals with classroom realities.

In addition to internal planning mechanisms, institutions frequently rely on **external funding sources and alternative financial strategies**. Project-based funding is a common mechanism for acquiring new technologies, with respondents noting that "project funding has been attracted to equip classrooms" (IST-5, 5 years). Some schools also explore innovative solutions to generate additional income, such as renting out facilities, where "the funds obtained are used to purchase new equipment." These practices demonstrate the resourcefulness of institutions in addressing funding gaps.

Despite these efforts, respondents identify numerous challenges that complicate the planning and implementation of technological investments. One of the most significant barriers is **limited financial resources**. This issue is particularly pronounced in smaller schools, where budget constraints are more acute. As one participant stated, "as a small school, financial resources are limited, and funding has decreased due to administrative reforms" (EL-3, 6 years). Others emphasise that "insufficient technological provision is due to financial considerations" (EL-2, 9 years), even when there is clear interest from teachers. Budget limitations are frequently described as the primary constraint, with respondents noting that "the main difficulties are related to finances and allocated budgets" (IST-8).

Another major challenge concerns **centralised procurement systems**, which often fail to address the specific needs of individual schools. Respondents express frustration that "centralised purchasing does not allow schools to receive equipment tailored to their needs" (IST-2, 7 years), and in some cases, decision-making processes prioritise cost over functionality, as "the municipality will choose the cheapest option" (IST-7, 2 years). This disconnect between policy-level decisions and local needs can limit the effectiveness of technological investments and reduce their pedagogical relevance.

In addition to acquisition challenges, **maintenance and sustainability of technologies** emerge as critical concerns. Respondents emphasise that the introduction of new technologies entails ongoing costs related to maintenance, updates, and technical support. As one participant explained, "the biggest difficulties are related to updating and maintaining technologies" (EL-5, 10 years), noting that financial resources for these purposes are often insufficient. Another respondent highlighted that "any additional equipment requires repairs, updates, and maintenance—someone must take responsibility for this, and it must be funded." These findings point to the importance of considering long-term sustainability in planning processes.

Challenges are also evident in the area of **communication and strategic alignment**. Ineffective communication with governing bodies can hinder timely planning and decision-making. For example, respondents report that "untimely communication with the municipality complicates planning" (EL-2, 9 years), while others note a "lack of a clear vision and direction" in centrally driven initiatives. This suggests that successful technology planning requires not only resources but also coherent governance and transparent communication.

Infrastructural and spatial limitations further constrain technological development. Even when resources are available, schools may face difficulties in integrating new technologies due to limited physical capacity. As one respondent noted, “the primary consideration is the capacity of the premises… the challenge is where to place the technologies” (EL-4, 20 years). This highlights the often-overlooked role of physical infrastructure in enabling or limiting digital transformation.

The collected data indicates that planning technological development in education requires a careful balance between strategic vision, stakeholder involvement, and resource management. While institutions demonstrate adaptive and creative approaches to planning, systemic constraints continue to shape the scope and effectiveness of technological innovation.

Pre-service teachers remain largely detached from planning processes, perceiving them as opaque and externally controlled. Their perspective is shaped mainly by observable outcomes, particularly inequalities between urban and rural schools and limited access to technology in non-STEM subjects.

Practicing teachers occupy an intermediate position, participating in needs identification but experiencing limited influence over final decisions. Their responses highlight tensions between pedagogical needs and financial constraints, including delays, underfunding, and the frequent selection of cost-efficient rather than pedagogically appropriate solutions.

School leaders approach technology investment as a strategic and systemic process, balancing long-term development goals with administrative, financial, and infrastructural constraints. Their perspective emphasises sustainability, including maintenance costs, alignment with institutional needs, and the importance of teacher competence over mere acquisition of equipment.

These differences point to a fragmented planning ecosystem in which perceptions range from external observation to operational frustration and strategic responsibility, indicating the need for more coherent and inclusive approaches to technology investment in education.

9. Please describe your experience of engaging in professional development.

The analysis of interviews with school leaders, teachers, and students reveals that experiences in professional development are highly diverse, encompassing formal academic studies, structured in-service training, self-directed learning, and collaborative knowledge exchange. This diversity reflects the evolving nature of professional learning in education, where multiple pathways contribute to competence development.

One of the most significant forms of professional development identified in the data is **academic study, particularly at the master’s level**, which is often perceived as comprehensive and transformative. Respondents emphasise that such studies provide both theoretical grounding and practical tools for integrating technology into teaching. As one participant noted, “these master’s studies were very valuable, as they provided many practical tools for working with technologies while also emphasising that technology is not central—the goal is more important” (IST-5, 5 years). Others highlight the breadth

of learning achieved, suggesting that “master’s studies replaced a large number of individual courses,” and that “the time invested in master’s studies is comparable to that spent in many different training courses.” These findings suggest that formal academic programmes can play a central role in developing integrated professional competences.

Another important dimension is the emphasis on **practical relevance and immediate applicability**. Respondents consistently value professional development experiences that provide concrete tools and methods that can be directly implemented in their work. For example, one participant described selected courses as successful because “they included specific practical approaches that could be immediately integrated into practice” (IST-3, 3 years). The importance of relevance is further emphasised by the observation that “it is important to learn what is immediately useful and can be applied in one’s work” (IST-2, 7 years). Practical, hands-on formats are particularly appreciated, as illustrated by references to events such as “E-skills Day… with lectures that included practical elements useful for every teacher.” Timeliness also plays a role, with respondents noting that courses are most valuable when “the topic is relevant at that particular moment,” enhancing their perceived impact.

A substantial portion of professional learning occurs through **self-directed and informal learning practices**. Many respondents report independently acquiring knowledge through online resources, experimentation, and participation in projects. One participant stated that they have “learned a lot through self-study” (IST-2, 7 years), while another noted that they “often learn new technologies and solutions independently… with artificial intelligence being very helpful” (EL-5, 10 years). Engagement in projects, conferences, and professional discussions is also highlighted as a means of growth, with respondents emphasising the importance of “opportunities to develop through participation in projects and exchange of ideas” (EL-1, 18 years). These findings point to the increasing significance of autonomous and flexible learning pathways in professional development.

Closely related to informal learning is the role of **peer collaboration and internal knowledge sharing within schools**. Educational institutions often develop internal mechanisms to support professional learning through collective practices. Respondents describe initiatives such as workshops, “idea fairs” (EL-1, 18 years), and collaborative groups where teachers can share experiences and learn from one another. For instance, one participant reported organising sessions for colleagues on the use of technologies, while another described leading working groups in which teachers “learned to use various Google tools” (IST-9). These practices highlight the importance of collegial learning and distributed expertise in supporting professional development.

Professional growth is also supported through **international experiences and alternative learning communities**, particularly among school leaders and innovative practitioners. Respondents refer to participation in international training programmes and professional networks as valuable sources of new perspectives and practices. For example, one school leader described engaging in continuous professional development through a learning community such as the “Directors’ Academy” (EL-2, 9 years), while others reported participating in courses and training not only in Latvia but also abroad,

including in Italy and the Czech Republic. These experiences contribute to the expansion of professional horizons and the adoption of global practices in local contexts.

At the same time, respondents express **criticism and dissatisfaction with certain aspects of professional development provision**, particularly regarding the quality and relevance of available courses. Some participants perceive existing training opportunities as overly theoretical and disconnected from practical classroom realities. As one respondent stated, “most courses offered in Latvia no longer appeal, as they lack quality, intensity, and international participation” (IST-10). Others highlight the limited applicability of acquired knowledge, noting that “the digital tools learned during studies were not usable in real classroom situations” (PST-5, 1 year). Professional development is also sometimes experienced as an additional burden, with respondents indicating that “courses can become an extra load alongside already high workloads” (IST-3, 3 years). In some cases, there is a mismatch between training content and institutional context, as “what is learned in training does not correspond to the real situation in the school” (PST-4, 6 years). These concerns point to the need for more context-sensitive, practice-oriented, and flexible professional development models.

It can be concluded that professional development in digital education is shaped by a dynamic interplay between formal, informal, and collaborative learning processes. The effectiveness of these experiences depends largely on their relevance, applicability, and alignment with the realities of educational practice.

Pre-service teachers emphasise the gap between theory and practice, highlighting that tools learned at university are “sometimes unusable in real school settings” (PST-5, 1 year). They value experiences that build confidence and demonstrate practical applicability, especially in real classroom contexts.

Practicing teachers prioritise immediate usability and hands-on learning, favouring approaches that offer “concrete, practical techniques” (IST-3, 3 years) for classroom use. At the same time, professional development is often perceived as an additional burden, particularly when it is theoretical and not integrated into working hours.

School leaders adopt a strategic perspective, focusing on institutional development, networking, and collaborative learning environments. They value informal learning spaces where “the environment is very accepting, open, and positive” (EL-2, 9 years), as well as project-based and self-directed learning.

These differences suggest the need for differentiated yet aligned professional development approaches that address practical, individual, and systemic dimensions.

10. What would an ideal professional development experience look like to enable you to use digital tools confidently in the learning process? How would it be implemented, with whom would you collaborate, and what would you learn?

The analysis of interview summaries indicates that ideal professional development in the context of digital education is perceived as practical, goal-oriented, and integrated into teachers’ daily work. Such professional learning experiences are expected to reduce anxiety, enhance confidence, and provide

immediate added value to teaching practice. The findings highlight that effective professional development is not limited to knowledge acquisition but also encompasses organisational conditions, collaboration, and psychological support.

A central dimension concerns the **mode of implementation and learning environment**. Respondents emphasise the importance of allocating dedicated time for professional development within working hours, suggesting that learning should not be treated as an additional burden. As one participant noted, “in an ideal world, there would be specific time allocated for professional development during working hours - once a week or twice a month” (IST-2, 7 years). The learning environment itself is also considered crucial, with respondents highlighting the need for distraction-free conditions: “courses should take place on a free day or week, when there are no parallel tasks, in an inspiring environment with full technical provision.” Small group formats and hands-on engagement are particularly valued, as “it would be beneficial if the training group were small (~12 participants), each with access to a computer… allowing immediate application of tools.” A gradual learning pace is also emphasised, with participants recommending to “teach calmly and slowly, starting from simple concepts and progressing to more complex ones” (IST-2, 7 years). These insights suggest that both organisational structure and learning design significantly influence the effectiveness of professional development.

Another important aspect relates to **collaboration and access to expertise**. Respondents stress that meaningful professional development requires engagement with practitioners who have real-world experience. As one participant stated, “it is most valuable to learn from professionals and experts who teach what they actually practice in their daily work” (IST-8). Mentorship is highlighted as a particularly effective form of support, with suggestions that “each teacher should have a mentor who observes lessons and supports the implementation of what was learned in the courses” (PST-7, 4 years). In addition, cross-institutional collaboration is seen as essential, with respondents advocating for “cooperation between schools, universities, innovation centres, researchers, and companies” (IST-3, 3 years). Local networking also plays a significant role, as creating “a collaboration network where teachers share experiences, insights, and materials” (IST-5, 5 years) fosters collective learning and professional growth.

The findings further indicate that teachers expect professional development to provide **relevant knowledge and practical skills** that extend beyond technical competence. A key expectation is the ability to integrate technology meaningfully into teaching. Respondents describe the need for “a coherent understanding of how to connect subject knowledge with pedagogical skills and how technology can support this process” (IST-3, 3 years). There is also strong interest in learning about current tools and applications, with participants expressing a desire to “learn about the top 20 most relevant applications and tools and how they can be used in different parts of a lesson.” Artificial intelligence is identified as a particularly relevant area, with respondents wishing to explore “what can be achieved with the help of AI and how digital tools can save time” (EL-1, 18 years). Content creation skills are also emphasised, with participants highlighting the need for “practical guidance on how to develop materials,” which could contribute to building “a widely accessible repository of resources in the Latvian language” (IST-10).

These expectations reflect a demand for professional development that directly supports classroom practice and innovation.

In addition to cognitive and practical outcomes, respondents highlight the importance of **psychological impact and confidence building**. Effective professional development is expected to reduce fear and increase teachers' sense of competence in using technologies. As one participant explained, the goal is to "gain self-confidence and feel capable of teaching and accomplishing everything" (IST-7, 2 years). Another respondent emphasised the importance of encouragement, noting a desire to "gain not only knowledge but also a general confidence in using technologies in the learning process." These findings suggest that emotional and motivational dimensions are integral to successful professional learning, particularly in the context of digital transformation, where uncertainty and rapid change can create anxiety.

The collected opinions demonstrate that ideal professional development in digital education is characterised by the integration of organisational support, collaborative learning, practical relevance, and psychological empowerment. Such an approach aligns professional learning closely with the realities of teaching practice and supports sustainable competence development in rapidly evolving educational environments.

These differences reveal a multi-layered structure of professional development needs, suggesting that effective approaches must integrate individual, pedagogical, and institutional dimensions, ensuring both practical support and strategic direction for development.

Summary of all the perspectives are summarized in table 1.

Table 1. Perspectives of the three stakeholder groups across the interview themes

Theme	Pre-service teachers	In-service teachers	School leaders
Route into the role	Intrinsic motivation: vocation, early aspiration, inspiring teachers; job stability also weighed	Non-linear: career change, alternative programmes, "accidental" entry; commitment built through practice	Gradual progression after leadership potential was recognised; teaching experience combined with strategic vision, sometimes from outside the school sector
View of technology and future challenges	Critical but balanced; health effects, skill degradation, unequal access, language barriers, AI and student independence	Pragmatic; workload, teaching quality, lack of time and resources, superficial use without pedagogical purpose; AI both support and threat to integrity	Strategic and systemic; organisational efficiency, sustainability, resource allocation, infrastructure maintenance, staff resistance
Barriers to integration	Societal and developmental; access inequality, loss of fundamental skills, health and behavioural risks, gap between university training and school reality	Practical and operational; workload, time, shortage of quality materials, AI altering assessment, infrastructure	Financial sustainability, administrative constraints, centralised procurement, staff resistance, limits of physical premises
Competences needed now	Technical agility, troubleshooting, information literacy, flexibility — an operational level of engagement	Pedagogical integration, alignment with didactic goals, evaluation of tools by pedagogical value, language skills, psychological readiness	Change management, communication, team development, supportive environments, data-informed decisions
Competences needed in future	Technical independence, navigating AI-generated content, adaptability, balancing technology in students' lives	Pedagogical integration and professional maturity, critical thinking, self-directed learning, English, emotional intelligence, data security	Long-term development, meaningful use of AI, data for decision-making, professional networks
Technology investment planning	Detached; process perceived as opaque and externally controlled; aware mainly of outcomes such as urban–rural inequality	Participate in identifying needs but hold little influence over decisions; tension between pedagogical need and budget; delays, underfunding, cheapest-option selection	Strategic and systemic; sustainability and maintenance costs, alignment with institutional needs, teacher competence valued over acquisition
Experience of professional development	Gap between theory and practice; university tools "sometimes unusable in real school settings";	Immediate usability and hands-on learning; PD experienced as an additional burden when	Institutional development, networking, informal and accepting learning spaces, project-

	value confidence-building	theoretical and outside working hours	based and self-directed learning
Ideal professional development	Innovation, international experience, adaptive approaches, mentor support	Time within working hours, immediate applicability, concrete classroom tools	Systemic development, data use, strategic collaboration with research and innovation sectors

Read across the eight themes, the three groups are not describing different problems but the same problem from different distances. Pre-service teachers consistently occupy the widest angle and the least leverage: they identify societal consequences and structural inequality while remaining outside the processes that produce them, and they see technology investment as something that happens to schools rather than in them. In-service teachers describe the same phenomena in terms of what they cost to enact - time, preparation, materials that do not exist in Latvian, and participate in decisions without determining them. Leaders describe the conditions under which others work, and are in turn constrained by municipal procurement and budgets they do not control. Each group therefore names the level immediately above it as the source of the constraint. The pattern is not that competence accumulates as careers progress, but that what a person can see, and what they are held responsible for, is set by where they stand.

Discussion

This study set out to establish how pre-service teachers, in-service teachers and educational leaders in Latvia understand the competences required to digitalise teaching and learning, and what they identify as the obstacles to it. Interviewing all three groups within one national system, using a common protocol, makes visible something that single-group studies cannot: the extent to which the answer depends on who is asked.

Competence as a function of position rather than career stage

The clearest pattern in the data is that what participants named as necessary competence varied systematically with their position in the system. Pre-service teachers described operational fluency, knowing how to use computers and phones, connecting hardware, troubleshooting when a device fails mid-lesson, and possessing basic proficiency in standard applications. In-service teachers described the selection and integration of tools: judging what a tool contributes, weighing its costs and limitations, and aligning its use with an intended learning outcome. Educational leaders described neither, speaking instead of leading change, assembling teams with the right expertise, and being a step ahead of the staff they are asking to move.

This has a direct bearing on how competence frameworks are read. DigCompEdu (Redecker, 2017) presents its areas as dimensions an individual educator holds simultaneously, with progression expressed as increasing proficiency within each. The present data suggest that the areas are not equally visible from every position: what a participant identified as *the* competence question was largely

determined by the problems their role made salient. A similar observation applies to TPCK (Mishra & Koehler, 2006). The integration of technological, pedagogical and content knowledge that the model places at its centre is essentially what in-service teachers described; pre-service teachers described the technological circle in relative isolation. If that difference is not simply an artefact of sampling, it suggests that the integrative element of TPCK is acquired in the classroom rather than in initial preparation, which is consistent with evidence that pre-service teachers' technology competence depends on modelling by teacher educators and authentic school experience rather than on instruction about technology as such (Tondeur et al., 2018).

It is important to be precise about what this pattern does and does not show. The design is cross-sectional, so the differences between groups cannot be attributed to career development. The heterogeneity of entry routes in this sample argues against reading them that way: participants reached their current roles by markedly different paths, several pre-service teachers were already teaching - one for six years (PST-4), and one leader described the route to the position as never having been an intentional goal (EL-2). What the data support is a claim about vantage point, not about sequence.

First- and second-order barriers, and why equipment does not resolve them

Participants named obstacles of two distinct kinds, corresponding closely to Ertmer's (1999) distinction between first-order barriers external to the teacher and second-order barriers internal to them. The external barriers were concrete and frequently financial: a small rural school whose funding fell after administrative reform (EL-3), centralised municipal procurement that prevents schools from receiving equipment matched to their needs (EL-2, IST-2), a municipality that approves the cheapest option available (IST-7), and funding that covers acquisition but not maintenance or licence renewal (EL-5).

The internal barriers were affective. Teachers were described as afraid of making mistakes and therefore avoiding technology altogether (EL-4, IST-5), as fearing the unfamiliar (IST-8), and as unwilling to change late in a career (EL-1). What matters analytically is that these were reported alongside adequate provision as often as in its absence. One teacher described a school where the state had supplied equipment that could not be connected to the systems already in place (IST-9): the provision existed and was unusable. This qualifies accounts that treat infrastructure and funding as the primary constraint (Göltl et al., 2024) and adds a mechanism to the spatial inequalities documented for Latvia by Hazans et al. (2025). Where investment programmes are evaluated by devices delivered, the second-order barrier is not merely unaddressed; it is invisible to the evaluation.

Language as a double constraint

The finding least anticipated by the existing literature concerns language, which operated in two directions at once.

In the first direction, English functioned as a gateway. Participants identified English proficiency as a condition of using tools whose interfaces and documentation are in English (PST-3) and of accessing

international professional learning; one leader listed foreign language skills among the competences that will matter most in future, on the grounds that they allow knowledge to be brought in from outside the system (EL-4), and another named English explicitly alongside the recognition that no IT professional can know everything (EL-2). The self-directed, independent professional learning that many participants described as their main route to competence is, in practice, learning conducted in English.

In the second direction, the scarcity of Latvian-language resources constrained what could be used in the classroom. One teacher contrasted the abundance of ready-made, levelled, assessed materials available for English with their near-absence for Latvian, and questioned the quality of the Latvian materials that do exist, noting errors that a teacher cannot correct (IST-11). Another reported that Latvian-language resources are few and of poor quality, and that materials developed in Latvia are not disseminated to the teachers who could use them (IST-10). A third described the absence of teaching materials that would make advanced equipment usable at all (EL-5).

Competence frameworks written for large-language education systems, including DigComp 2.2 (Vuorikari et al., 2022) and DigCompEdu (Redecker, 2017), assume that resources exist in the language of instruction and therefore treat resource selection as a matter of professional judgement. In a small-language system that assumption does not hold, and selection becomes constrained by availability. This connects the present findings to evidence that digitalisation policies generate new inequalities where the needs of specific contexts are not built into them (Castaño-Muñoz et al., 2025) and to comparative work on smaller European systems (Stupurienė & Gülbahar, 2022). It also illustrates the more general caution that technology tends to reproduce existing patterns of advantage unless deliberately deployed otherwise (Selwyn, 2016) - here along an axis of language rather than of income. The policy implication is that producing high-quality resources in the language of instruction is not a supplementary activity but a precondition for the competences these frameworks describe.

Artificial intelligence as a problem of assessment rather than of teaching

Concerns about artificial intelligence clustered almost entirely on assessment. Teachers reported that students had become adept at using AI for tests and essays, and located the difficulty in designing tasks whose answers are not readily retrievable (IST-7); that producing an assessment which minimises copying has become substantially harder (IST-11); and that students now question the purpose of learning something an AI can supply (IST-3).

What is notable is what appeared rarely: AI as an instrument of teaching. Where it did appear, it was in relation to the educator's own work rather than to students' learning - automating administrative processes and supporting self-directed learning (EL-5), or as something a leader wished to understand better in order to save time (EL-1).

Read against evidence that the effects of technology-enhanced learning depend on the learning activity the technology supports rather than on the technology itself (Sailer et al., 2024), this asymmetry is instructive. The difficulty participants describe is not created by AI; it is created by assessment formats

designed on the assumption that unaided production could be inferred from the finished product. Framed that way, the task facing teachers is redesign rather than detection - a shift also urged in UNESCO's global guidance, which frames generative AI as requiring revision of how learning is assessed and validated rather than prohibition, and which explicitly flags linguistic and cultural diversity among the values such revision must protect (Miao & Holmes, 2023), a considerably more demanding requirement, and one that current professional development provision, as participants described it, does not address.

Fear of error, professional identity and peer-led change

The affective barriers described above are better understood as a matter of professional identity than of skill. Professional identity is continuously reconstructed through experience and interaction rather than settled at qualification (Beijaard et al., 2004), and it is destabilised where external demands conflict with an established sense of purpose (Day et al., 2006). Introducing an unfamiliar tool requires a teacher to risk visible incompetence in front of students who may be more fluent with it - an asymmetry one leader named directly, while also observing that students' apparent fluency does not extend to using technology for learning (EL-4).

Where change did spread, it spread horizontally. One leader described the adoption of Moodle beginning with her own use, extending to enthusiast colleagues, then to a wider group through an external project, and eventually to most of the staff, and stated explicitly that resistance is greatest when adoption is perceived as imposed by management (EL-2). Others described running sessions for colleagues before the start of the school year (IST-3) and introducing a platform early in the pandemic before training the rest of the staff (IST-10).

This is consistent with evidence that the leadership practices most reliably associated with technology integration are building professional capacity and creating communities of practice (Dexter & Richardson, 2020). The present data suggest a reason: peer-led diffusion lowers the identity cost of adoption, because learning from a colleague who has already failed publicly makes failure survivable in a way that formal training does not. Professional development that addresses tool proficiency alone therefore leaves the operative obstacle untouched.

A planning system in which no one is the author

A final pattern cuts across all three groups. Each located technology decision-making somewhere other than its own position. Pre-service teachers largely did not know how such decisions were made (PST-9). Teachers reported being able to state preferences without determining outcomes, whether through an annual questionnaire (IST-2) or a request that the municipality answers with the cheapest available option (IST-7). Leaders - the group the other two identified as responsible, described themselves as constrained in turn: by a municipal IT unit that plans procurement centrally and communicates too late for planning to be possible (EL-2), and by a dismissive attitude towards the needs of small schools (EL-3).

The result is a process in which no participant group experiences itself as the author of the decisions that shape its working conditions. This is a governance finding rather than a competence finding, and it qualifies an assumption common in the digital leadership literature: that school leaders control the technological environment they are being asked to lead.

Implications

Three implications follow. For policy, the production and dissemination of high-quality digital resources in the language of instruction should be treated as infrastructure rather than as content, and procurement should admit school-level specification of need. For institutional leadership, the constraints participants described most consistently - time and the visibility of failure, are addressed by protecting time within the working week and by supporting the peer-led diffusion that the data show already carries most change. For teacher education, the integrative competence that in-service teachers describe appears to be learned in practice, which argues for its being modelled in authentic school settings rather than taught about (Tondeur et al., 2018).

Limitations

The design of this study places clear limits on what can be inferred from it. The account is cross-sectional: differences between the three groups can be described, but they cannot be attributed to career development. Cohort, role and selection effects cannot be distinguished from developmental change — leaders may emphasise strategy because their position requires it, because strategic dispositions preceded their appointment, or because they were trained in a different technological era than today's pre-service teachers. A longitudinal design following pre-service teachers into practice, or a comparison of newly appointed with long-serving leaders, would be needed to separate these explanations. Further, the sample of 32 purposively selected participants does not support statistical generalisation; not every participant is quoted in the Results, so the coded extracts represent the range of perspectives rather than their distribution across the sample. The data are self-reported and were not triangulated with classroom observation or institutional documents, and all quotations were translated from Latvian, so nuances of the original phrasing may have been lost.

Cosnclusions

This study asked how pre-service teachers, in-service teachers and educational leaders in Latvia conceptualise the competences required for effective digitalisation of teaching and learning, and what they identify as the principal obstacles to it. The answer is that there is no single conceptualisation. What counted as necessary competence varied with the respondent's position in the education system: pre-service teachers foregrounded operational and troubleshooting skills, in-service teachers the selection and pedagogical integration of tools, and educational leaders the management of institutional change. These are not three stages of one trajectory but three vantage points on one problem - the classroom, the school and the institution, and the differences between them are best read as a function of what each position makes visible and holds its occupant accountable for.

The obstacles participants named followed the same logic. Each group located the principal constraint at the level immediately above its own: pre-service teachers described technology decisions as opaque and externally determined, teachers described participating in decisions without determining them, and leaders described being constrained by municipal procurement and budgets they did not control. The result is a planning process in which no group experiences itself as the author of the decisions that shape its working conditions.

Three findings warrant particular emphasis. First, barriers internal to teachers, fear of error, and reluctance to change late in a career, persisted in well-resourced settings as well as poorly resourced ones, which means that investment measured in equipment delivered will not register them. Second, language operated as a double constraint: English proficiency governed access to tools and professional learning, while the scarcity of high-quality Latvian-language resources limited what could be used in the classroom. This mechanism is largely absent from the competence frameworks that guide European digital education policy, which assume that resources exist in the language of instruction. Third, artificial intelligence was experienced overwhelmingly as a challenge to assessment rather than to teaching, which locates the difficulty in assessment formats rather than in the technology itself.

Recommendations

For policymakers. The production and dissemination of high-quality digital learning resources in the language of instruction should be treated as educational infrastructure rather than as optional content, and existing Latvian-language materials should be evaluated for quality and actively disseminated rather than assumed to be in use. Centralised procurement should admit school-level specification of need, particularly for small and rural schools. Investment programmes should be evaluated by documented pedagogical use rather than by devices delivered.

For school leaders. The two constraints participants reported most consistently were time and the visibility of failure. Both are addressable at institutional level: by protecting time for professional learning within the working week rather than adding it to existing workload, and by supporting the peer-led diffusion that, on this evidence, already carries most successful change. Where adoption was perceived as imposed from above, resistance was greater; where a colleague had already tried and failed publicly, adoption spread.

For teacher educators. The integrative competence that in-service teachers described appears to be acquired in the classroom rather than in initial preparation, which argues for technology integration being modelled in authentic school settings rather than taught about. Two further needs follow from the findings: English proficiency functions as a precondition for independent professional learning and should be addressed explicitly rather than assumed; and the redesign of assessment under conditions of widely available generative AI is a competence that current provision, as participants described it, does not yet develop.

Directions for further research

The cross-sectional design of this study permits differences between groups to be described but not attributed to career development. A longitudinal design following pre-service teachers into practice, or a comparison of newly appointed with long-serving leaders, would allow cohort, role and selection effects to be separated. Because the present analysis reports the Latvian dataset only, comparison with the parallel datasets collected in the other IDEAL Futures partner countries would establish whether the double language constraint identified here is specific to small-language education systems or has analogues elsewhere. Two further lines follow directly from the findings: classroom observation to triangulate what teachers report against what they do, and design-based work on assessment formats that remain valid when generative AI is freely available to students.

Digital transformation in Latvian schools is not principally limited by the availability of technology. It is limited by resources that do not exist in the language of instruction, by decision-making processes that no participant group recognises as its own, and by the professional risk a teacher takes in being seen not to know. None of these is resolved by procurement.

Declarations

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and with the ethical principles governing research with human participants, including voluntary participation, informed consent, the right to withdraw at any point without consequence, confidentiality, and the anonymisation of all personal and institutional identifiers.

Research ethics

Ethical approval was obtained from Mary Immaculate College JFREC ethics committee approval no A23-043. All participants provided written informed consent, were assured of their right to withdraw from the study at any time and were guaranteed anonymity and confidentiality in the presentation of the findings.

Informed consent was obtained from all participants involved in the study. Participants were informed in advance about the purpose of the research, the intended use of the data, the audio recording of interviews, and their right to withdraw. Consent was recorded at the beginning of each interview.

Consent to publish

All participants provided written informed consent prior to participation, including consent for the publication of anonymised data and quotations. No information that could identify individual

participants is included in this article.

Data Availability Statement

The interview transcripts generated and analysed during this study are not publicly available in order to protect the confidentiality of participants, who could be identifiable within a small national education system. Anonymised extracts are available from the corresponding author on reasonable request.

Author Contributions

The first author prepared the manuscript and carried out the data analysis. The co-authors contributed to conducting the interviews, to the data analysis, and to fact-checking. All authors have read and agreed to the published version of the manuscript.

Use of Artificial Intelligence

The Claude Opus 5 model (Anthropic) was used for English-language editing of the manuscript. The authors reviewed and edited the output and take full responsibility for the content of the publication.

Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analysis or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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