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Identifying Teacher Needs and Requirements for XR Integration in Secondary Technical and Vocational Education

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Abstract. Extended Reality (XR) is increasingly recognized as a valuable educational tool. The Flemish *XR-Actieplan* is an initiative established to improve technical and vocational students' skills, focusing on making XR materials accessible and professionalizing educators in their use. A key initiative within this plan, the *XR Lerend Netwerk*, engaged 25 schools in an intensive program from September 2023 to June 2024 to explore effective XR integration. This study investigates the needs and requirements of secondary technical and vocational school teachers to sustain XR-enhanced teaching post-program. Using a mixed-methods approach, we gathered data through year-long observations and focus group discussions with 23 teachers, divided into groups focusing on VR, AR/MR, and 360° tools. Findings reveal a strong demand for accessible, curriculum-aligned software, intuitive hardware with flexible loan systems, and differentiated professional development opportunities. Teachers also highlighted the importance of institutional support and the need for collaborative platforms to share XR knowledge and strategies. This study underscores the importance of systemic alignment between resources, professional development, and institutional strategies to transform the educational potential of XR into a lasting practice.

Keywords: Technical and Vocational Education, Extended Reality, Teacher Needs and Requirements, XR for Learning.

1 Introduction

Extended Reality (XR) is an umbrella term encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). It has become increasingly popular in recent years and is slowly becoming more mature [1], further evidenced by developments such as Apple releasing its own device to the masses [2]. Due to this maturity of XR, its viability as an educational tool has grown [3, 4]. Additionally, secondary school teachers and students have begun showing interest in XR [5, 6].

While several studies emphasize the effectiveness of XR in education [7], questions remain about the specific factors and conditions that facilitate its integration. Jensen and Konradsen [4] and Johnson-Glenberg, Bartolomea, and Kalina [8] highlight the need to focus on design principles and elements critical for successful adoption. Moreover, Southgate and Smith [9] underscore the importance of applying these principles in a natural context rather than a laboratory setting.

In 2021, the Flemish Parliament released a vision statement, "Van Kwetsbaar naar Weerbaar" (translated as "From Vulnerable to Resilient"), discussing the need to provide vulnerable students in technical and vocational secondary education with a competitive edge in the labor market. Driven by this need and informed by discussions with experts, the *XR-Actieplan* was developed [10], aiming to use XR to improve students' skills.

The *XR-Actieplan* is built on four interconnected pillars aimed at lowering barriers to XR adoption. It seeks to make hardware, software, professional development, and pedagogical support accessible and free for educators, while also advancing research on XR. Each province in Flanders has a Regional Technical Center (RTC) that bridges the gap between technical and vocational education and industry. As the first pillar of the *XR-Actieplan*, these centers act as free rental hubs where schools can borrow carefully selected XR hardware, such as Pico headsets for VR and iPads for AR/MR, alongside a Mobile Device Management (MDM) system. Additionally, the RTCs have negotiated with developers and companies to equip these devices with relevant software. Currently, they have collected more than 150 XR applications, offering nearly 500 XR experiences, and six authoring tools

that enable schools to create and share their own XR content. To support educators in effectively using these resources, the *XR Academy* was established as the second pillar of the initiative. This professionalization effort trains teachers, ICT coordinators, and school management in the use of XR technology, ensuring they are equipped to implement and support XR in schools. Didactic integration, however, is the focus of the third pillar: the *XR Lerend Netwerk*, a learning network that helps teachers integrate XR into their lessons with pedagogical strategies. From September 2023 to June 2024, the *XR Lerend Netwerk* engaged 25 schools in an intensive program aimed at effectively implementing XR in educational practices. Spearheaded by Thomas More University of Applied Sciences, in collaboration with HoWest, HoGent, PXL, and UCLL, the *XR Lerend Netwerk* co-developed didactic guidelines with participating schools. The fourth pillar is the research component, which adopts the methodological framework of educational design research. This pillar aims to capture the effectiveness of the *XR-Actieplan* while explicitly developing, testing, and validating design guidelines for sustainable XR implementation in education. All four pillars are coordinated by the Kennis- en Adviescentrum Digisprong (KACD), which oversees strategic decisions for the *XR-Actieplan* within the Flemish Department of Education.

As the project nears its conclusion, questions arise regarding the continuation of professionalization efforts, hardware, and software access. Schools are now reflecting on the needs and requirements necessary to sustain XR-enhanced teaching.

2 Aim

In this study, we aim to chart the requirements and needs of technical and vocational secondary school teachers to effectively use XR in the classroom as an educational tool, specifically focusing on those who have used XR intensively in the classroom before and are willing to continue doing so.

3 Methodology

Our study employs a mixed-methods approach to gather empirical data. The project received ethical approval (G-2023 12 2175) and adheres to established guidelines for conducting research in educational contexts. Data collection consisted of two components: year-long observations and end-of-year focus group discussions with participating teachers, for which a separate informed consent process was implemented, ensuring that participants received a dedicated information letter and oral briefing before voluntarily taking part. Discussions were audio-recorded and pseudonymized to protect participant anonymity.

During the 2023–2024 school year, the *XR Lerend Netwerk* observed 25 participating schools. At the end of the year, focus groups were conducted with 23 secondary school teachers from across the five Flemish provinces, evenly distributed across three groups: Augmented and Mixed Reality, Virtual Reality, and 360° tools.

Participants, teaching students aged 14-18, had diverse backgrounds and XR experience, offering varied insights. Each session was facilitated by a researcher familiar with the *XR Lerend Netwerk* and lasted approximately one hour. First, teachers were invited to reflect on the past year, identifying both successful experiences (such as effective applications, teaching methods, or lesson preparations) and the challenges they encountered (including technical difficulties, pedagogical limitations, or organizational constraints). Second, the discussion shifted to an evaluation of the support provided during the project, with teachers assessing whether it had been sufficient and identifying any gaps. Third, teachers were asked to look towards the future, considering whether they planned to continue using XR and what factors influenced their decision. Additionally, they discussed potential new XR tools or applications and whether they expected additional hurdles in implementing them. Finally, the sessions concluded with reflections on what was still needed for sustained XR integration including funding, time, professional development, or technical support. All groups followed the same discussion framework; however, moderators encouraged participants to elaborate on key topics and share practical insights.

4 Findings and Discussion

We found that the needs and requirements addressed by teachers were numerous and related to software, hardware, professional development, institutional support, and also led us to some obstacles.

4.1 Software

During the *XR-Actieplan,* teachers were provided with an increasingly expanding software library, which was a crucial step in addressing teachers' needs. Teachers noticed that, while they understand that licenses and software

packages can be expensive, especially for Flemish schools, it is of paramount importance to provide them with a variety of applications that run smoothly and are didactically sound. They emphasized the need for ICT coordinators to prepare everything beforehand, allowing teachers to focus on their core tasks.

One teacher highlighted the importance of having an overview of applications per subject area, stating: “Om [XR] interessant te maken [voor leerkrachten], zou er een overzicht moeten zijn van de applicaties per vakgebied.” (translated: "To make XR truly engaging for teachers, there should be an overview of applications for each subject area.") Having a clear, structured list of professional and relevant applications would help teachers integrate XR more effectively into their lessons.

Additionally, software solutions must align with curricular goals and competencies. Applications meeting these requirements are not always readily available, which leads teachers to rely on authoring tools that allow them to create their own experiences. While 360° tools are the easiest to use and are considered invaluable for virtual tours and internship preparation, teachers find them lacking in interactivity compared to dedicated XR lesson packages. For specific objectives, such as instructing how to use specific machinery or demonstrating technical procedures, other authoring tools like Fectar [11] or Dexr [12] are considered ideal solutions.

4.2 Recommendations from Teachers

- Develop and fund software that aligns with educational standards, ensuring clear links to curriculum goals
- Maintain an up-to-date overview of XR applications categorized by subject area, helping teachers find relevant tools more easily
- Invest in authoring tools that enable teachers to create and adapt XR content for their own lessons
- Equip ICT coordinators with the resources and time needed to test and integrate XR applications into school infrastructure

4.3 Hardware

During the *XR-Actieplan*, teachers were provided with XR hardware, including iVR HMDs for VR and Tablets for AR/MR, alongside a Mobile Device Management (MDM) system. These devices were lent out to schools for free for a few weeks at a time.

Based on our year-long observations, we identified 3 main criteria for effective XR hardware integration. First, ease of use is critical, with plug-and-play functionality being essential to encourage adoption among teachers. Complex setups or lengthy installation processes often deter teachers from using the technology, making simplicity a top priority. Second, accessibility is paramount; hardware must be readily available to schools. Teachers who are hesitant about XR are unlikely to adopt it if they must travel far to access the necessary devices. Third, flexible loan periods are indispensable. Schools need adaptable lending systems that allow both short-term trials and long-term usage, depending on their specific needs.

By addressing these criteria, teachers find XR hardware can become a more practical and appealing tool for educational use. However, successful implementation requires a structured approach to hardware distribution, teacher support, and institutional policies.

4.4 Recommendations from Teachers

- Ensure XR hardware is intuitive and pre-configured, minimizing setup time for teachers
- Ensure that XR hardware is both easy to reserve and physically accessible
- Develop a flexible lending policy that accommodates both short-term and long-term needs

4.5 Professional Development

During the *XR-Actieplan*, teachers received free training sessions on both a technical level and an educational level. Teachers indicate that this can be expanded upon by offering differentiated training sessions tailored to schools’ varying levels of experience and competence. Beginners benefit from introductory sessions about the basic principles of XR, while advanced users require in-depth workshops on complex applications or authoring tools for developing educational content.

Focus group discussions of the *XR Lerend Netwerk* revealed a strong demand for peer exchange and networking opportunities. Teachers valued collaborative meetings during the intensive program, emphasizing their practical benefits. They expressed the need for an overarching platform dedicated to peer interactions, XR knowledge sharing, and discussions.

Self-experimentation emerged as a critical learning component, with teachers emphasizing the need for time to explore XR independently after initial guidance. However, despite their need for self-experimentation, teachers

also emphasized that they require a structured framework to guide them. One teacher articulated this need clearly: “Het enige dat ik nog mis, is een kader voor, tijdens, en na.” (translated: "The only thing I still miss is a framework for before, during, and after.") They stressed that simply providing hardware and software was not enough. Because XR is still new to many teachers, the lack of a clear roadmap for preparing, implementing, and evaluating XR activities in a pedagogically meaningful way creates a barrier that some may not feel confident enough to overcome.

4.6 Recommendations from Teachers

- Offer professionalization opportunities tailored to different skill levels, from introductory sessions to advanced workshops
- Create an online platform for teachers to exchange knowledge, share best practices, and access support
- Develop a structured framework for XR integration, outlining preparation, implementation, and evaluation strategies
- Provide dedicated time and resources for teachers to experiment with XR applications and refine their lessons

4.7 Institutional Support

While the *XR Lerend Netwerk* successfully focused on supporting teachers, teachers highlighted the need for greater involvement from school management and ICT coordinators to ensure long-term success. A dual approach combining bottom-up (teacher-led) and top-down (policy-driven) strategies is essential. Tools such as Digisnap [13] and the XR Scan [14] can assist schools in identifying competency gaps and tracking progress, enabling targeted professional development. Providing schools with tools for self-assessment and offering tailored professional development sessions based on their results are crucial to sustain momentum.

Additionally, teachers agreed that companies and the government should also fully commit to XR development. One teacher remarked: “Als het gesubsidieerd is, dan gaat de kwaliteit naar boven gaan.” (translated: "If it is subsidized, the quality will improve.") These perspectives highlight the need for sustained investment and structured funding mechanisms to enhance the quality and long-term adoption of XR in education.

4.8 Recommendations from Teachers

- Encourage school management to invest in XR-related professional development initiatives
- Equip schools with assessment tools to evaluate and track their XR readiness and progress
- Foster collaboration between policymakers, industry, and schools to align XR investments with educational priorities

4.9 Limitations and Obstacles

Although the *XR-Actieplan* achieved significant progress, several obstacles remained unaddressed and highlighted limitations in its design and implementation.

One key issue was the limited testing opportunities for teachers. To adequately prepare for lessons, teachers need the ability to test XR at home, but the *XR-Actieplan* restricted the use of devices to school hours only. This limitation hinders teachers' ability to explore XR technology independently and gain confidence in using it effectively in their classrooms.

Another challenge lay in the evaluation of XR lessons. The process was complicated by inconsistent tools and the use of multiple applications. While some applications provided built-in evaluation options, these were often incompatible with the existing evaluation platforms used by schools, making it difficult to accurately assess students' progress.

Additionally, supporting students during XR lessons posed significant challenges. Although screen casting is a helpful tool, technical issues frequently hindered its effectiveness, leaving teachers struggling to guide students effectively during XR activities. Addressing these obstacles requires systemic changes and more robust solutions to ensure a smoother integration of XR in educational settings.

Limited ICT literacy remains a barrier to XR adoption. Some teachers lack the foundational skills to navigate new technologies, which hinders their confidence in using XR effectively. While this challenge extends beyond XR and the *XR-Actieplan*, we think integrating basic ICT training into professional development programs alongside hands-on XR training could help bridge this gap.

Many of these obstacles surfaced during the implementation of the *XR-Actieplan* or fell outside its scope. Future initiatives should tackle these challenges from the outset, focusing on expanding access to XR tools beyond school settings and collaborating with developers to establish standardized evaluation and support frameworks.

5 Conclusion

The *XR-Actieplan* has demonstrated the transformative potential of Extended Reality (XR) in Flemish secondary technical and vocational education, equipping students with skills through innovative tools that align with labor market demands. This study highlights the importance of addressing interconnected factors and fostering collaboration and alignment across key areas—technology, teacher training, and institutional frameworks—to ensure XR becomes a sustainable part of everyday educational practice.

Teachers highlighted the necessity for user-friendly and curriculum-aligned software. The use of authoring tools emerged as a key recommendation, enabling educators to create tailored and personalized learning experiences. Additionally, ensuring intuitive and readily accessible hardware is critical for fostering adoption, particularly among educators less familiar with XR technologies. Setting up flexible loan systems and simplifying setups are pivotal for widespread implementation.

Professional development should not only be maintained but also expanded with differentiated training programs that cater to schools' varying levels of experience, offering both foundational and advanced sessions. These training opportunities should be embedded within a broader strategy that combines formal training with peer learning, experimentation, and long-term support. Establishing a shared platform for collaboration and knowledge sharing among teachers is crucial to reinforce these efforts and foster a community of practice.

Institutional support requires well-coordinated efforts and commitment from all stakeholders, including ICT coordinators and school management, with guidance and support from policymakers. ICT coordinators should ensure that XR technology is easily accessible and user-friendly. School management must invest in tools and strategies to address gaps in both technological and pedagogical competencies, while policymakers can play a facilitating role by addressing systemic challenges such as limited opportunities for independent testing, inconsistent evaluation tools, and varying levels of ICT literacy. Collaboration across these levels ensures teachers can successfully integrate XR into their classrooms.

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