HOW TECHNOLOGY IMPROVES STUDENTS' LEARNING

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Abstract: *This paper explores how technology helps improve students' learning by combining findings from the OECD Education Working Paper No. 335 (Forsström et al., 2025) and Carstens et al. (2021). Based on research and existing studies, it reviews the educational value of tools such as artificial intelligence (AI), extended reality (XR), robotics, gaming, and digital media. Using a comparative literature review, the study examines data on how technology influences student engagement, motivation, collaboration, and skill development. The results show that when technology is used with clear teaching goals, it can significantly improve students' cognitive, emotional, and social learning. However, these benefits depend on teacher skills, equal access, and responsible use. The paper concludes that digital tools can greatly support personalized and active learning, but their success relies on thoughtful design and ongoing teacher training.*

Keywords: *technology in education, digital learning, student motivation, cognitive development, teaching strategies, educational innovation, ICT integration*

INTRODUCTION

Fast changes in technology have reshaped education, transforming how students learn and develop new skills. From early learning software to AI-based learning systems, technology is now a central part of classrooms around the world. Forsström et al. (2025) note that digital tools can increase engagement, creativity, and teamwork, but their positive effects depend on how teachers use them in lessons, not just on having access to them. Similarly, Carstens et al. (2021) found that technology motivates students and makes learning more enjoyable, though it can also lead to management issues or dependence on digital tools. To truly understand how

technology improves learning, it is essential to look not only at the tools themselves but also at how schools and teachers integrate them effectively. The goal of this paper is to explore how technology improves student learning by reviewing recent research and educational policies. It focuses on three main questions:

1. How does technology improve learning outcomes in terms of knowledge and motivation?

2. What teaching and contextual factors make technology effective in education?

3. What challenges or risks come with using technology in learning?

METHODS

This article uses a comparative literature review based on two key sources. The first is The Impact of Digital Technologies on Students' Learning by Forsström et al. (2025), which compiles data from many systematic reviews and meta-analyses about how digital tools affect learning in primary and secondary schools. The second is Effects of Technology on Student Learning by Carstens et al. (2021), which reports on a survey of K–12 teachers about the advantages and disadvantages of technology use in classrooms.

Data Sources and Analysis

OECD (2025): This paper provides a substantial amount of evidence based on aggregated data. It evaluates how tools like programming, AI, gaming, and media learning influence student performance and engagement.

Carstens et al. (2021): This study provides practical insights from teachers, highlighting benefits like increased motivation and flexibility, along with challenges such as technical issues and over-reliance on devices. The information from both papers was compared through thematic analysis across four categories:

1. Cognitive outcomes, including problem-solving, reasoning, and academic achievement.

2. Motivational outcomes, including engagement, autonomy, and self-confidence.

3. Teaching practices, focusing on how teachers integrate technology and manage classrooms.

4. Structural factors, such as access to devices, teacher training, and equity.

These categories were used to find common themes and patterns showing how technology improves learning.

RESULTS

1. Cognitive Improvement through Digital Tools:

Forsström et al. (2025) report that digital technologies improve students' ability to think logically, solve problems, and be creative. Programming and robotics help develop computational thinking, while gaming and simulations increase understanding in science and mathematics. The meta-analyses showed moderate to large effects (for example, $g = 0.49$–0.81) for technology-based learning. Virtual and augmented reality tools also support understanding complex concepts by allowing students to visualize and interact with content.

Carstens et al. (2021) found similar results from a classroom perspective. Teachers said that technology made it easier to personalize learning, allowing students to move at their own pace and work on creative projects. These experiences strengthened students' thinking skills and helped them connect theory with practice.

2. Motivation and Engagement:

Both studies agree that technology increases motivation and participation. Forsström et al. (2025) explain that, according to Self-Determination Theory, technology satisfies students' psychological needs for autonomy, competence, and social connection. Games and interactive software make learning more enjoyable by providing quick feedback and achievable goals. Carstens et al. (2021) found that students were more eager to learn when technology was used, as it reflected the digital environments they already used outside of school. Online collaboration tools also help students work in groups and support one another. This strengthens emotional and social involvement, making learning more active and meaningful.

3. Changes in Teaching Practices:

Technology has changed the teacher's role. Forsström et al. (2025) emphasize that digital tools work best when teachers align them with learning goals. Teachers who use technology to give feedback, guide reflection, and promote collaboration see the strongest results. However, success depends on training and support.

Carstens et al. (2021) observed that teachers are increasingly becoming facilitators who help students explore and create rather than simply deliver content. Yet, many teachers said they lacked time or technical skills to use technology effectively. This highlights the importance of ongoing professional development and school investment.

4. Access and Equity:

According to the OECD (2025), digital learning opportunities are not equal everywhere. Students from wealthier backgrounds or better-equipped schools gain more benefits, while those without devices or internet access may fall behind. Carstens et al. (2021) also found similar gaps. Some classrooms had one device per student, while others had to share. Teachers emphasized that to make digital learning fair, schools need both financial support and time for proper training and planning.

DISCUSSION

Both studies show that technology improves students' learning through three main pathways: cognitive development, motivation, and better teaching methods. Technology supports cognitive growth by making learning interactive and problem-based. It boosts motivation by giving students autonomy and real-time feedback. It also encourages teachers to use innovative and personalized approaches that increase engagement. Still, these advantages appear only when technology is carefully planned and guided by teaching goals. Forsström et al. (2025) warn that access alone is not enough to improve outcomes. Similarly, Carstens et al. (2021) report that a lack of training, time, or technical support can make digital tools frustrating instead of helpful. This means that technology works best as part of a supportive environment that includes teacher skills, proper infrastructure, and digital literacy.

Cognitive Load Theory helps explain why technology can be effective. Visual and interactive digital tools can simplify difficult information, reduce unnecessary mental effort, and help students focus on learning (Sweller et al., 2011, cited in OECD, 2025). Likewise, Self-Determination Theory (Deci & Ryan, 1985) explains how technology supports intrinsic motivation through autonomy and feedback, which makes learning more enjoyable and self-driven.

While technology brings many benefits, there are also challenges: Overuse and distraction: Some students depend too much on devices or get distracted by unrelated activities (Carstens et al., 2021). Technical problems: Internet issues or slow systems waste teaching time and reduce lesson flow. Skill balance: Too much typing may reduce handwriting practice and fine-motor development. Ethical issues: The OECD (2025) notes that AI tools raise privacy and data security concerns.

These problems can be reduced by teaching digital responsibility, improving school infrastructure, and using a balanced mix of digital and traditional methods.

For policymakers, the findings suggest that investment should not only focus on purchasing technology but also on teacher training and curriculum design. Schools need professional learning programs that combine technical and teaching skills. Teachers should be trained to select the right digital tools and use them effectively. For schools, using blended learning, flipped classrooms, and interactive feedback systems can make technology-based teaching more successful. Collaboration between teachers, parents, and education authorities is also essential for long-term improvement and equity.

CONCLUSION

Technology now plays an essential role in modern education. When used properly, it supports critical thinking, creativity, and motivation. Evidence from Forsström et al. (2025) and Carstens et al. (2021) shows that digital tools work best when guided by good teaching practices, teacher expertise, and equal access for all students.

Future research should continue exploring how new tools like artificial intelligence, virtual reality, and adaptive platforms influence long-term learning. Technology should not replace teachers but rather help them create more engaging, inclusive, and effective classrooms where every student can reach their potential.

Taken together, the findings from this research suggest that improving students' learning through technology requires a balanced and integrated approach. Effective teaching should combine digital tools with strategies that encourage students to think critically and engage actively with content. Interactive, student-centered environments—such as collaborative projects, discussions, and group problem solving—allow students to participate more deeply in the learning process. At the same time, teachers should use insights from global research and adapt modern technologies to meet the needs of today's learners.

This combined approach not only enhances academic outcomes but also builds students' independence, confidence, and long-term motivation to learn. Therefore, educators are encouraged to adopt flexible, inclusive, and research-informed teaching methods to make technology-based learning more effective, equitable, and enjoyable for all students.

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