5.0 Introduction

Software updated – but what about learning?

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KEY MESSAGES

- **A fourth generational shift is underway in digital learning resources.** This marks a deeper transformation than before and a move towards a self-regulating digital ecosystem. The new generation of adaptive digital learning resources enables a more personalised and flexible approach to learning, drawing on artificial intelligence and distributed systems. The distinction between proprietary and open educational resources is increasingly blurred.
- **AI can help reduce educational inequalities and support inclusive teaching** by offering new learning opportunities and assisting teachers where resources are limited. However, its use must be informed and responsible: AI is not a cure-all, and alongside opportunities we must also recognise risks, such as widening inequality and declining learning skills.
- **The focus should be on learners' needs rather than on technological options.** Dependence on specific service providers (vendor lock-in) should be avoided, and new technologies, including AI, should be used cautiously, also considering emerging risks.
- **Digital developments call for a rethinking of the aims of education and a willingness to experiment both boldly and responsibly.** The human being must remain at the centre.

INTRODUCTION

Education is the foundation of Estonia's future. Although our small country has gained international recognition for the performance of its education system, as reflected in PISA results, it now faces new challenges that demand systemic and bold change. Rapid technological progress, widening socio-economic disparities, the expanding role of digital education, and the evolving needs of teachers and learners all influence the coherence and long-term resilience of the education system.

WHAT WILL THE NEXT DECADE BRING?

Over the coming decade, the teacher's role will increasingly evolve into that of a mentor and facilitator of the learning process who helps

pupils use digital technologies to maximise their learning. At the same time, pupils will gain greater autonomy and responsibility for managing their own learning. A key question is whether – and how – the human connection between teachers and learners can be maintained. Collaborative learning environments and hands-on activities are likely to grow in importance. The Covid-19 pandemic and the resulting digital leap challenged teachers to adapt to new methods. In the next decade, a balance will emerge between digital and traditional approaches. Continuous professional development will be essential for teachers to use adaptive teaching tools effectively while maintaining high-quality learning experiences. At the same time, the need for mental health support will increase, as the constant use of technology can heighten anxiety and stress among both teachers and pupils.

AI-driven learning analytics will enable schools and teachers to monitor pupils' progress and learning outcomes with greater precision. Data-based decision-making will allow teachers to adjust teaching methods more quickly and accurately, while deeper data analysis will help identify learning difficulties at an early stage. This, however, also calls for stronger data protection measures and the development of the ability to critically interpret data.

Over the next decade, more evidence will emerge on how digital technologies affect learning outcomes. Although current findings are mixed, future assessments will provide a clearer understanding of implementation quality and allow for more targeted improvement. Greater investment in educational innovation will help ensure that new technologies promote deeper and more lasting learning.

Educational technology will also become more accessible for pupils with special needs. AI-based learning solutions will offer personalised support, such as speech recognition, text-to-speech functions and virtual tutors. Schools will invest more in technological solutions that ensure equal access to learning for all pupils.

The wider use of digital learning materials and asynchronous study depends largely on technological infrastructure. Estonia is already a highly advanced digital nation, but in the next decade it will need to ensure fast internet connectivity and up-to-date devices in every school. More investment will be directed towards improving access to digital tools in smaller schools and rural areas, reducing regional disparities and providing equal learning opportunities for all.

Looking ahead, policymakers and schools alike must address the question of how to guarantee every child in Estonia access to high-quality education, regardless of location or socio-economic background. The use of technology in education must be guided by deliberate choices that support both teachers and learners on their path of development.

This chapter focuses on four critical areas: adaptive learning materials, the use of AI, the legal challenges of regulating technology, and responsible digital innovation. Together, these will largely determine how well Estonia's education system can meet current and future demands. They are vital not only for education policymakers but also for schools, teachers and families whose children need learning that is both high-quality and accessible.

SMART DIGITAL LEARNING RESOURCES ARE EVOLVING INTO AN ADAPTIVE ECOSYSTEM

In the first article of the chapter, Mart Laanpere and Hans Põldoja discuss how education can be made more flexible and adaptive, providing learning experiences tailored to individual needs. At the same time, it is crucial to ensure that technology is equally accessible to all learners, regardless of their socio-economic background or place of residence. Developing teachers' digital competence and supporting the acquisition of technological infrastructure must be supported.

SMART USE OF ARTIFICIAL INTELLIGENCE REQUIRES HUMAN INTELLIGENCE

In the second article, Birgy Lorenz and Kaspar Kruup explore new ways for education to offer personalised learning opportunities while strengthening critical thinking and problem-

solving skills. Yet the use of AI can also deepen inequalities between those with access to resources and skills and those without. AI-based learning is most effective when pupils possess sufficient self-regulation skills. Its use must therefore be guided by a clear ethical framework that ensures the protection of privacy and personal data. Training for both pupils and teachers in the use of new technologies is essential to prevent the negative effects of AI on education.

ESTONIA'S EDUCATION SYSTEM IN THE WINDS OF TECHNOLOGICAL AND LEGAL CHANGE

In the third article, Kaido Kikkas and Riin Saadjärv highlight the challenges posed by technological dependency, which can limit the innovative capacity and autonomy of Estonia's education system. To ensure the best opportunities for pupils and teachers, decisions should prioritise the use of domestic solutions and help avoid dependence on large foreign corporations. It is also necessary to find ways to prevent vendor lock-in and guarantee equal access for all schools and learners. Addressing legal and ethical issues – particularly those concerning data protection and privacy – is vital to ensure the responsible use of technology.

TODAY'S CLASSROOMS ARE IN URGENT NEED OF DIGITAL INNOVATION

In the fourth article, Margus Pedaste and Emanuele Bardone emphasise that educational technology must support learners' all-round development. Digital solutions should not remain mere instruments of technological substitution but should instead promote qualitative and inclusive learning processes.

The responsible use of digital technologies in education requires more than simply integrating them into teaching; it calls for a deep understanding of how technology can transform learning and teaching. New technologies must support pupils' critical thinking, capacity for collaboration and autonomy. Innovation must take into account social and ethical dimensions, as well as the shared role of teachers and learners in shaping the classroom of the future.

These areas are crucial for ensuring the sustainability of Estonian education. Decision-makers must make informed choices for a future in which every child and teacher has access to high-quality educational opportunities, regardless of their location or resources.

HOW DO WE MOVE FORWARD?

Expectations for innovation and the smart use of digital technology in education are rising, but this potential often remains unrealised due to systemic barriers, fear, fragmentation and insufficient digital competence. The reflections that accompany the four articles highlight key issues and propose concrete ways forward.

- Clear and forward-looking rules for data use must be established to enable the collection and analysis of information on how educational digital tools are used and what impact they have. Such rules should protect users' rights while at the same time supporting the development and interoperability of the digital ecosystem.
- Only evidence-based and learning-supportive AI solutions should be developed and adopted – those designed to help pupils overcome individual learning obstacles. Creating an intelligent learning coach could help learners become more self-directed and less dependent on AI-generated answers.
- Teachers need systematic and meaningful digital competence development, along with support to overcome concerns related to copyright, data protection and AI. Awareness-raising and practical guidance should help them use digital technologies in education safely and confidently.
- Educational innovation requires strategic, research-informed external support – including mentors, architects, researchers and funding – and room for bold experimentation in forward-looking schools, while maintaining ethical responsibility and ensuring alternative learning opportunities for pupils.

Laps kasutas AI-d
kes on süüdi ?!