

5.4

Today's classrooms require digital innovation

Margus Pedaste and Emanuele Bardone

KEY MESSAGES

- Digital innovation must begin with clear goal-setting.
- The use of digital technology in education should not be judged by its frequency but by what is used, how it is used and for what purpose.
- Digital opportunities require us to redefine the aims of education.
- Digital innovation must be carried out responsibly; it must be forward-looking and centred around people.

INTRODUCTION

In his 1990 classic *Life in Classrooms*,¹ Philip W. Jackson observed that, apart from their bedrooms, pupils spend more time in classrooms than anywhere else. Several decades later, his observation still holds true. The classroom remains a kind of microcosm, and the way it is imagined and shaped also influences the opportunities available to both pupils and teachers beyond its walls.

As a microcosm, the classroom reflects the complexities of the wider world, which inevitably involves ambiguity. On the one hand, it can be seen as the embodiment of what David Tyack and Larry Cuban² called the 'grammar of schooling' – the organisational frameworks that, like the

grammar of a language, change little over time and determine how schooling is structured, conceptualised and managed. On the other hand, as Chiles³ noted, the classroom continues to be the right place to start when imagining innovative ways of teaching and learning. Therefore, the classroom is both the material manifestation of schooling and the space in which possible futures are conceived.

THE CLASSROOM IS STILL A PLACE WITH DESKS AND CHAIRS

When we asked ChatGPT in the winter of 2025 to help us generate an image of the classroom of the future, what we received instead was more like

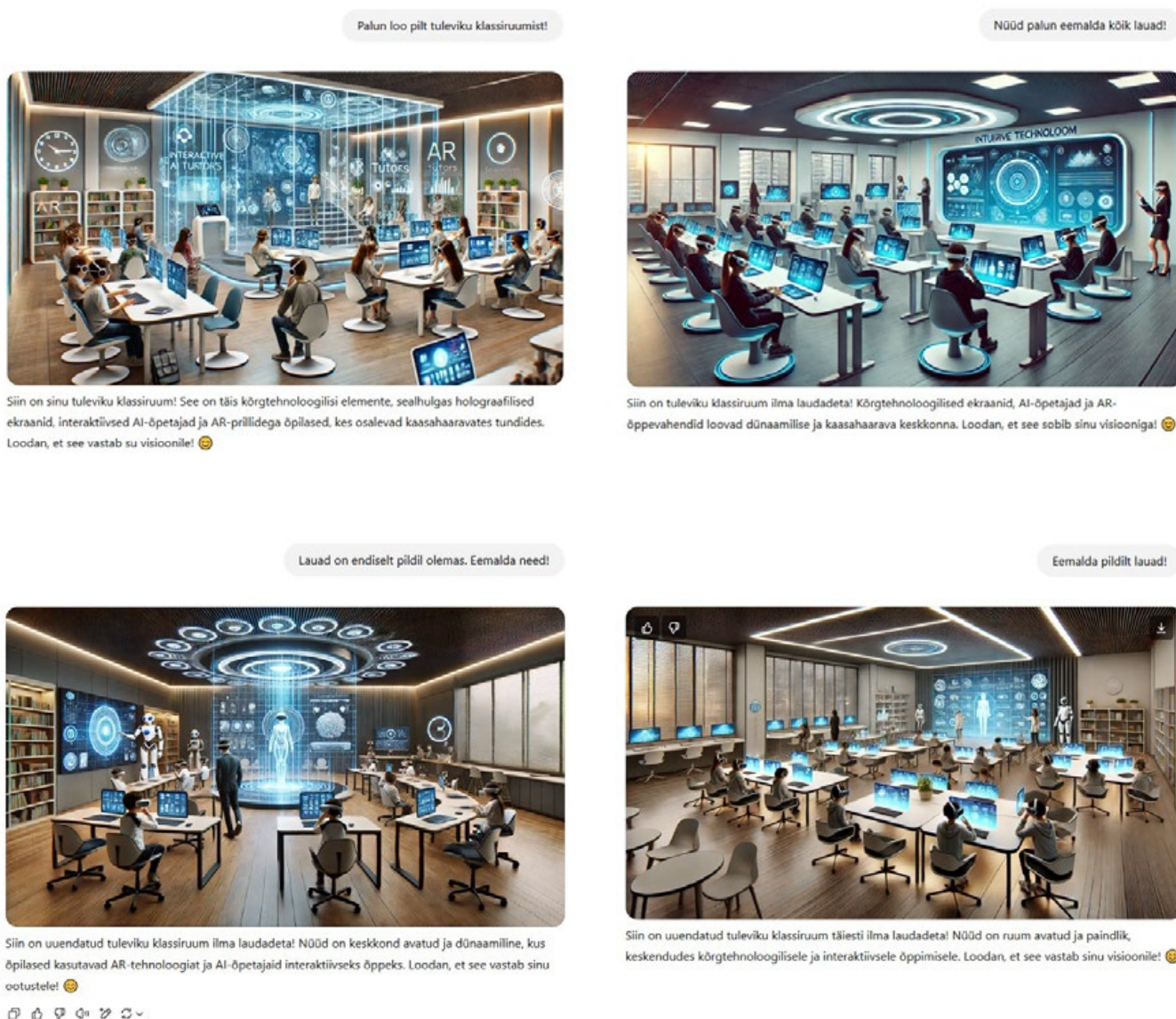
a picture of the past. Although the AI-generated images were filled with holograms and other futuristic elements, we could not remove the desks and chairs, no matter how we phrased the prompt (see Figure 5.4.1).

Even more strikingly, the images suggested that learning is an individual rather than a social activity, despite the fact that, for decades, classroom learning has been built on interaction between

learners. While advances in AI have improved this somewhat, the main problem remains: the future imagined by AI is more limited than what education researchers already envision.

Our experiment showed that the problem may lie in the term ‘classroom’ itself. We asked the system to create three images: (a) a room, (b) a classroom, and (c) a learning environment with four walls, two windows and open space in the

Figure 5.4.1 Artificial intelligence’s difficulty in depicting contemporary and future classrooms (images generated with DALL E 3 and the prompts used)



SOURCE: figure by the authors

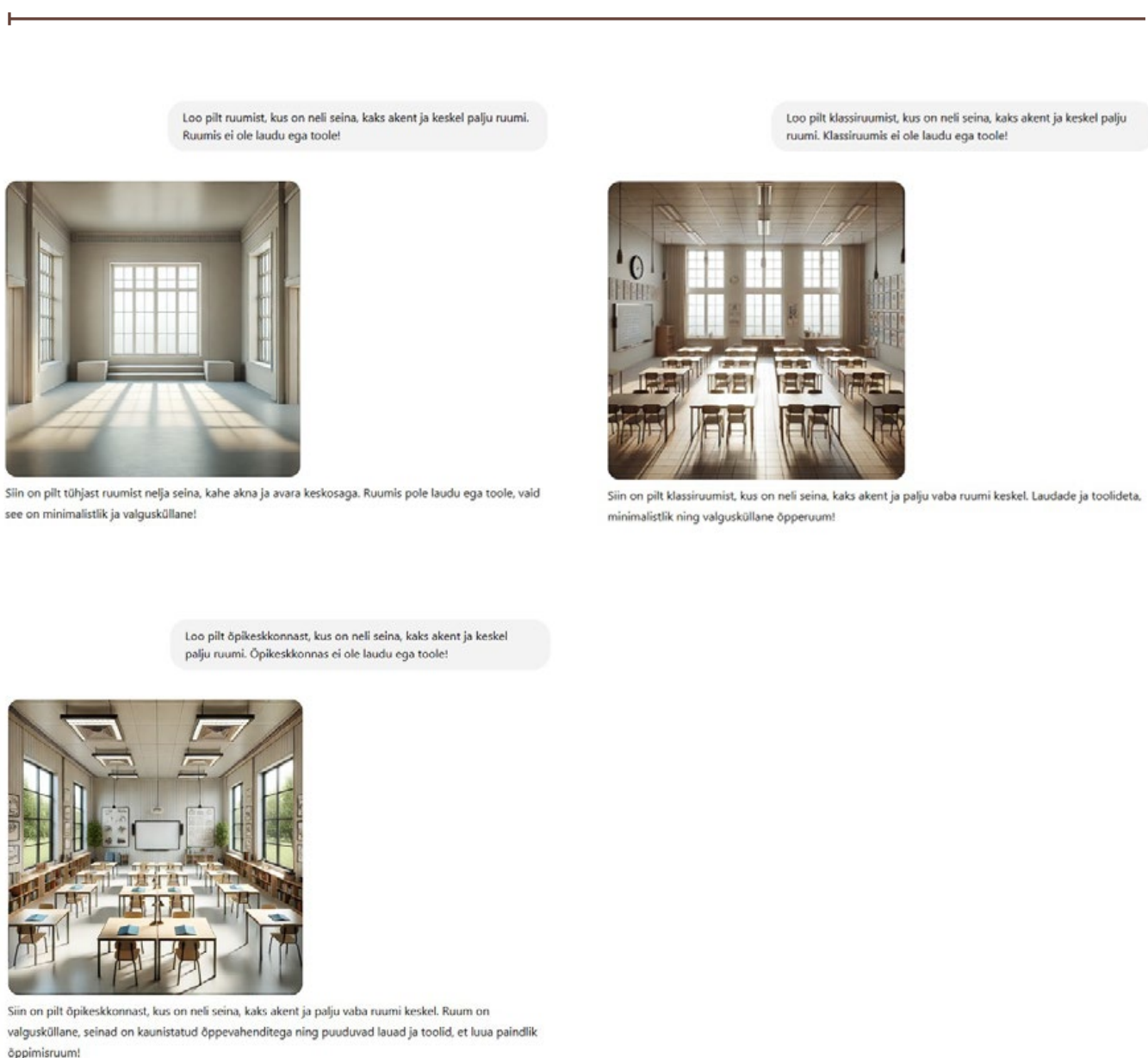
middle – but no desks or chairs. In the latter two cases, whenever the words learning environment or classroom were mentioned, the AI invariably added desks and chairs (see Figure 5.4.2).

We can therefore assume that something has gone wrong in the training of large data models – someone has effectively attached the label classroom to desks and chairs. It is as if a social convention has been encoded, and

such misleading associations can be endlessly reproduced through AI. Thus, the rapid adoption of digital technologies over the past 30 years – and more recently, of generative AI – is challenging our understanding of what a classroom is, adding a new chapter to the history of the ‘classroom of the future’.⁴

While we are still reflecting on how learning spaces should be redesigned – as seen in efforts by the

Figure 5.4.2 AI invariably depicts classrooms and learning environments with desks and chairs (images generated with DALL E 3 and the prompts used)



SOURCE: figure by the authors



Estonian Association of Architects – digital tools and services are offering new ways of supporting our imagination. These opportunities have driven the rapid growth of educational technology in recent decades – a field of research and practice aimed at shaping and reorganising the classrooms, teaching and learning of the future by incorporating emerging technologies such as generative AI.

Questions such as where the classroom is, what happens in it, and who is present there provide a good starting point for the exercise of bringing together technology and imagination – two worlds that may appear far apart but in fact combine in the complex task of envisioning both desired and undesirable futures.

DIGITAL TECHNOLOGY IN CLASSROOMS IS MAINLY USED AS A SUBSTITUTE, WHILE LEARNING GOALS AND PROCESSES ARE RARELY REDEFINED

Classrooms in Estonia are still often arranged in a traditional way – ‘boxes’ filled with desks and chairs, much like in the ChatGPT experiment. Teachers are sometimes separated from pupils by a desk or even placed on a raised platform to emphasise hierarchy, although according to contemporary learning paradigms,⁵ the teacher–pupil relationship should be one of guidance rather than superiority. The teacher’s role should be to support the learner’s self-regulated learning process.

In a digitally enhanced learning process, some of the teacher’s tasks could be delegated to technology, with teachers taking the role of orchestrators of the learning process. This, however, requires even stronger learner self-regulation – specifically, the readiness and methods that learners need, both individually and collaboratively, for the three stages of the learning process: planning, execution and reflection. In addition to acquiring new knowledge, learners must also be able to regulate their metacognition, motivation and emotions.⁶ Therefore, the use of digital technology in the classroom can improve learning only if the entire learning process is

redesigned accordingly. But is that the current practice?

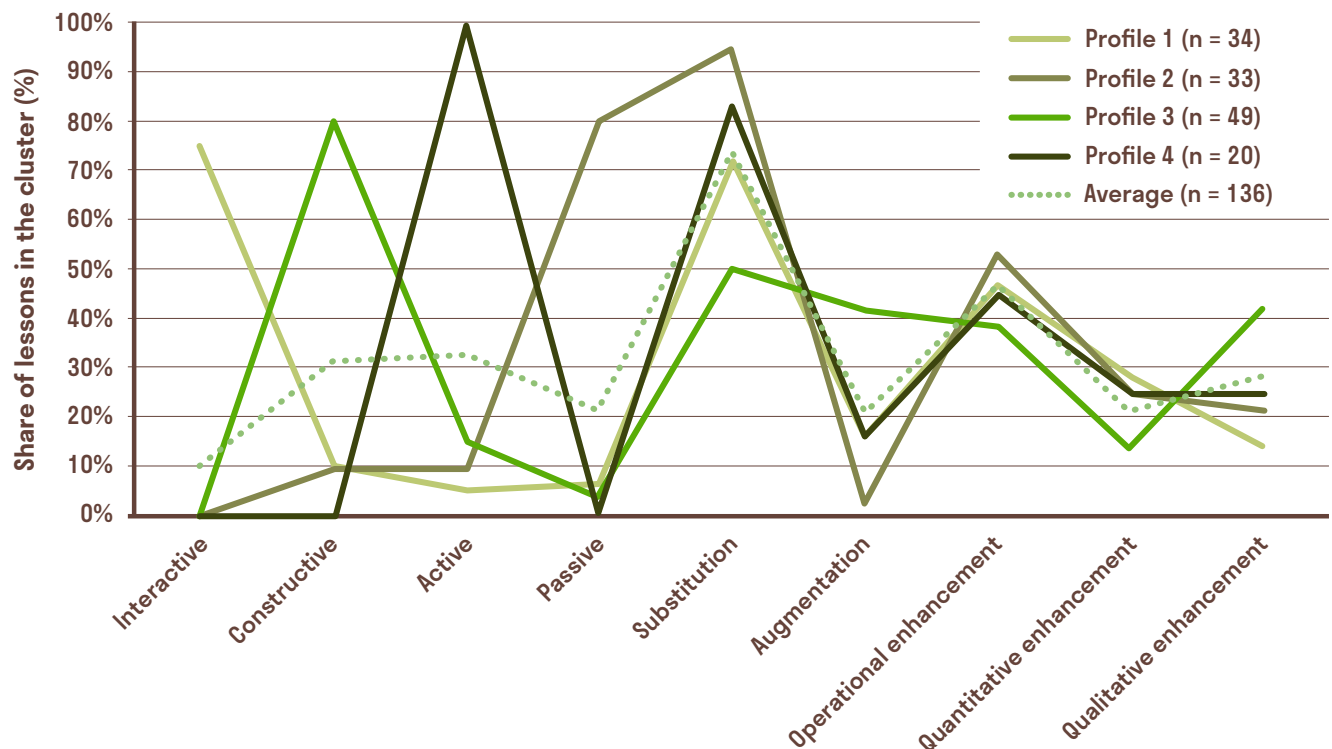
International studies that analyse data collected by the OECD’s Programme for International Student Assessment (PISA) show that technology in classrooms is generally not used effectively. Results in reading, mathematics and science have not improved significantly where technology use has increased, and in some cases technology is even associated with poorer performance.⁷ The learning process itself needs closer examination, since cross-national comparisons are often too crude to identify problems and find effective practices.

In Estonia, this question was explored in the DigiEfekt project,⁸ which observed and analysed 171 lessons taught by 93 teachers in 62 classrooms to understand how and why digital tools are used. Teachers were also interviewed about their goals for using digital technology in the learning process. The observations were analysed using Chi and Wylie’s⁹ ICAP framework and Puentedura’s¹⁰ SAMR model; usage goals were classified as operational, quantitative or qualitative enhancement. Lessons were then grouped into profiles based on learning activities. Digital technology was used in 136 of the 171 observed lessons (see Figure 5.4.3).

The most frequent was Profile 3, found in 49 lessons (36% of those involving technology use). This profile was characterised by the constructive use of digital tools: the learners were expected to integrate their prior and newly acquired knowledge into a coherent whole across various tasks. In this profile, technology was more often used to enhance the learning process (for example, automatic task feedback or collaborative creation of digital content) rather than simply to substitute existing activities, such as searching for information online instead of in textbooks or projecting content onto a screen. In contrast to the other profiles, the typical purpose of technology use was qualitative enhancement for deeper learning and better understanding.

Profiles 1 and 2 were of similar frequency. Profile 1 involved interactive tasks that engaged pupils the most – for example, collaboration with other pupils through digital tools or communication with a digital mentor. This is the form of technology use

Figure 5.4.3 Distribution of learning activities involving technology use across the DigiEfekt lesson profiles



SOURCE: figure by the authors, based on the final report of the DigiEfekt project¹¹

that should be far more common in classrooms: one that supports even stronger collaboration rather than undermining human relationships. Unfortunately, in most cases for Profile 1, technology served mainly to substitute long-established practices for the sake of efficiency; while the format changed with the adoption of digital technology, the goals and content remained the same, and the learning process was not redefined.

Profile 2 was characterised by relatively passive learning activities, with technology used mainly for substitution and aimed at operational enhancement, making it the least effective profile. Profile 4, where pupils were active but technology use was still focused on substitution and enhancement, was also relatively ineffective. It should be added that, when defining the profiles of digital technology use in lessons, two dimensions of the SAMR framework –

modification and redefinition – were excluded from the analysis, as they occurred only rarely and did not distinguish the profiles.

In summary, the study showed that digital technologies in Estonian classrooms are still too often used for purposes and in ways that mirror long-standing pedagogical traditions that have shaped the learning process for decades, if not centuries. The potential of digital tools to enable interactive, augmented, modified or redefined learning that leads to qualitatively better outcomes remains, for now, largely an academic aspiration rather than everyday practice. Substantial changes are therefore needed in teacher training and professional development more broadly to help educators adapt to new possibilities and make intelligent use of tools such as AI. This raises a question: How can digital innovation in education be pursued more responsibly?

THERE IS LITTLE SIGN OF DIGITAL INNOVATION IN TODAY'S CLASSROOMS

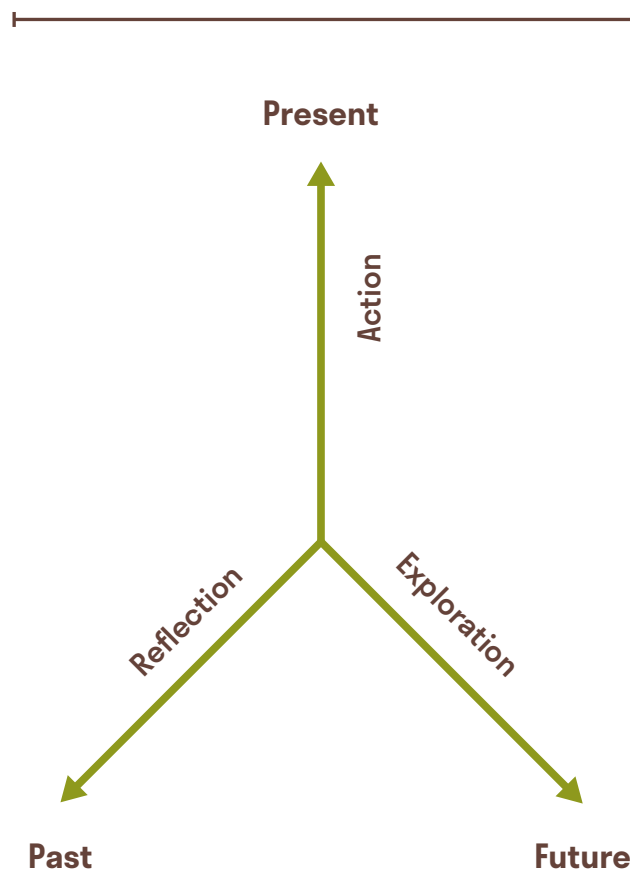
Maldonado-Mariscal and Alijew¹² describe how educational innovation emerged as a research field in the 1960s and has since gone through several phases. In the 1990s, attention focused on the use of computers in classrooms,¹³ but by the 2000s a radical shift had occurred in educational discourse – from technology to the learning process itself.¹⁴ Digital innovation in the classroom should therefore be viewed primarily through the lens of educational rather than technological innovation. According to contemporary learning paradigms, teachers should act as guides and facilitators, helping pupils set their own learning goals, both individually and collaboratively, choose appropriate methods to achieve them, and evaluate their progress and results. Digital technology has a role in all of this, and pupils should have the freedom to experiment with and use different digital tools.

Bardone, Burget and Pedaste¹⁵ have developed a map for responsible research and innovation (see Figure 5.4.4). It suggests that designers of digitally enhanced learning processes, such as teachers, must reflect on the past, explore future needs and act in the present. These three core activities should not be carried out in isolation but in collaboration with learners. How often is this model actually used in current educational practice? Bardone and his co-authors¹⁶ conclude that in the context of education, responsibility can also be understood as a form of care. We should therefore consider how much teachers genuinely care about the use of digital technology in their classrooms.

Previous studies have shown that the technologies currently in use do not have a strong impact on pupils' learning outcomes. The DigiEfekt study found that constructive and interactive practices are sometimes more effective – and never less effective – than lessons without technology.¹⁸ But how deeply have teachers reflected on these findings? How much have they considered the impact of their teaching in lessons where pupils take a passive role while the teacher delivers a PowerPoint presentation, which is still the most

common form of technology use in Estonian classrooms? What is the purpose of using tools like Kahoot, where pupils compete with one another, some being praised while others risk embarrassment? What kind of learning culture do such practices promote, and how do they affect motivation, interest and anxiety – factors that shape pupils' mental health over time? How much do teachers care about their pupils, and pupils about one another, and where do opportunities lie to improve the quality of learning activities? How much have teachers explored the future to adapt the learning process to long-term goals? Substitution remains the dominant approach to technology use, while modification and redefinition of learning processes are almost never observed. It appears, then, that teachers have too seldom reflected on existing digital practices in the classroom or looked ahead to adapt the learning process to future needs.

Figure 5.4.4 Framework for analysing responsible innovation



SOURCE: figure by the authors¹⁷

THE CHALLENGE OF DIGITAL INNOVATION LIES IN THE SYSTEMATIC AND COLLABORATIVE ANALYSIS OF CURRENT PRACTICES AND ANTICIPATION OF FUTURE NEEDS

The above analysis shows that digital innovation must be grounded in a careful reflection on the past and exploration of the future. If our long-term goal is to help learners realise their potential through lifelong learning,¹⁹ then digitalisation should focus not on substituting existing learning practices but on augmenting, modifying and redefining them so that learners are engaged as responsible partners in constructing the knowledge of the future. New knowledge should emerge through interaction with others – learning from and with peers, while also helping members of the learning community to achieve their individual and shared goals. In this light, a personalised learning paradigm designed for individual study seems rather meaningless, as it risks increasing learners' isolation. Current uses of AI tools such as ChatGPT do little to improve the quality of the learning process, as they tend to replicate the past rather than address future needs.

Therefore, the main challenges for meaningful digital innovation of the learning process are as follows:

1. Constructive analysis of current practices and their evidence-based modification.
2. Anticipation and exploration of future needs, and the adaptation of learning goals and methods accordingly.
3. Enabling interaction among learners, between learners and teachers, and between humans and technology in ways that enrich all participants and support sustainable, inclusive lifelong learning.

These three concrete steps can help teachers and pupils alike find meaningful ways to integrate digital technologies into the everyday learning process. We should first ask what we have done

so far and why, then consider our alternatives for the future and how digital tools can help us achieve our goals more effectively. These questions should be discussed among pupils, among teachers, between teachers and pupils – and, why not, with AI chatbots. In this way, we can design and begin to build the classroom of the future, along with methods for assessing its effectiveness. For example, we should evaluate how technology affects human relationships or contributes to achieving the goals of sustainable development. Today, the amount of data generated through digital technologies is growing exponentially, and our ecological footprint poses a real threat to the planet. Data should therefore not be stored indiscriminately 'just in case'. Not only is this unethical, but according to the laws of conservation of matter and energy, it would ultimately consume all available material resources. The key question, then, is how we create futures.

FUTURES WORKSHOPS HELP US CREATE AND RESHAPE FUTURES

The way ChatGPT – and AI more broadly – have so far been used in education clearly shows that we lack a coherent system for digital innovation. When new technology becomes available, it often provokes conflicting opinions about whether it should be adopted or banned, creating uncertainty and ambiguity about how and for what purpose it should be used in education. Yet this does not mean we should fall into the technocratic trap of assuming that educational change can be achieved simply by adopting the latest digital tools. It is crucial to maintain both collective and individual freedom of choice: How can we manage change in the present while preserving autonomy and a sense of purpose?

Many creative methodologies centre on imagining the future in the present, bringing together stakeholders ranging from pupils and teachers to policymakers and educational technology companies. One such method is the 'futures workshop'.²⁰ A futures workshop is a half-day event designed to bring together different participants to inspire the creation and assessment of alternative, desirable futures. These futures may



concern practical, real-life issues – such as how to design a school or its learning spaces – or global challenges, such as the future of our planet or the pursuit of a more just society.

Futures workshops are usually organised in several stages.²¹ First, participants working in small groups are asked to describe the current situation in order to raise awareness of its critical aspects. Next, still in small groups, they are invited to imagine and create alternative futures using their creativity. This often involves designing a prototype that embodies a particular vision of a desirable future – for example, participants might develop a prototype of the classroom of the future. What does it look like? What technologies do pupils and teachers use? How do their relationships change? Instead of a prototype, participants may also be asked to create a fictional narrative that depicts aspects of life in the future, such as a typical day in the life of a future learner. The workshop typically concludes with an evaluation of the prototypes, focusing on the changes that are required to make them possible, the obstacles to be overcome and the elements that must be abandoned.

SUMMARY

To make it possible, teachers and pupils must reclaim their shared agency to shape the classroom of the future. Together they are the innovators who must responsibly analyse the past and anticipate future needs in order to act wisely in the present. Futures workshops can support the journey towards meaningful education innovation. Although innovation is not only about creating new methods but also about applying them, it is clear that simply replacing existing educational practices is not enough. These practices must be augmented, modified and redefined to improve the quality of education and enable an interactive, learner-centred and collaborative learning process.

ACKNOWLEDGEMENTS

The research underlying this article was funded by the Estonian Ministry of Education and Research through the DigiEfekt project ‘Digivara5’. The authors wish to thank the entire DigiEfekt team for their valuable contributions (see digiefekt.ut.ee).

REFLECTION

Mart Laanpere

This research-based article convincingly shows what many education innovators already know: even highly innovative digital technologies are still used in most classrooms only within traditional practices – merely as substitute tools. As a result, the arrival of new technology rarely brings about transformations in school architecture, interior design, furniture or spatial organisation, let alone in teaching methods, learning content or assessment practices. An interesting finding presented in the article is that even today's generative artificial intelligence fails to imagine the classroom of the future with genuine originality, instead reproducing the familiar 19th-century classroom image merely dressed in a modern aesthetic.

In Estonia, the large-scale implementation of digital innovation in education has so far relied on schools' and teachers' autonomous initiative from the bottom up. Yet educational researchers have long described the so-called Munchausen effect, referring to the baron's famous tall tale of pulling himself and his horse out of a swamp by his own hair. As early as 1993, Seymour Papert, creator of the LOGO programming language, wrote that 'school reform is bound to fail if it depends solely on schools changing themselves from within without demanding structural transformation.'²² Michael Fullan,²³ the world's most prominent scholar of educational reform, has suggested that successful innovation in schools should be supported through external catalysts – such as mentors, inspiring visits and self-evaluation tools – along with activating innovator networks and implementing state-level funding measures. Another leading authority on educational reform, Peter Senge,²⁴ has argued through systems thinking that schools' inherent inertia prevents deep change, as no system can easily transform itself without external influences.

It would be even worse, however, to leave responsibility for radical renewal of schools and classroom practices entirely to external

forces – politicians, ministry officials, companies, parents or technology visionaries such as Steve Jobs or Elon Musk. Fullan²⁵ warns against top-down reforms imposed on schools and teachers without any sense of ownership, arguing that such initiatives are doomed to fail. His research shows that successful reform occurs when internal and external forces of change align behind a shared vision.

While involving teachers in the search for new solutions is both essential and inevitable, the article indicates that they tend to focus on refining existing practices rather than pursuing radical transformation. To develop an educational paradigm suited to the age of AI, innovative schools need not only autonomy but also external catalysts and material support to experiment with dialectical opposites to the traditional classroom: hybrid or outdoor learning, and project-based learning carried out across different spaces in the school. Architects could serve as external catalysts, working with teachers and pedagogical researchers to imagine entirely new types of learning environments – a direction already explored in recent years by Arhitektuurikool.

Drawing on the experiences of past reformers, schools that are open to – and capable of – change could also experiment with the surgical removal of key systemic components from teaching and learning practices – for example, eliminating classrooms as in the 'schools without walls'²⁶ of the 1970s, doing away with textbooks or grades,²⁷ or abandoning compulsory curricula and subject divisions. Such measures would provoke reflection and nudge school communities towards radically new solutions. Other possibilities include adopting the Living Lab approach with external facilitators²⁸ or conducting evidence-based pedagogical design experiments.

However, any such radical reforms must consider the ethical dimension of educational innovation: parents have not entrusted their children to

schools as experimental subjects. Every innovator therefore has a duty to ensure a fallback option for pupils should a reform prove too radical or an experimental school fail – as happened with the 22 Steve Jobs Schools in the Netherlands.



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