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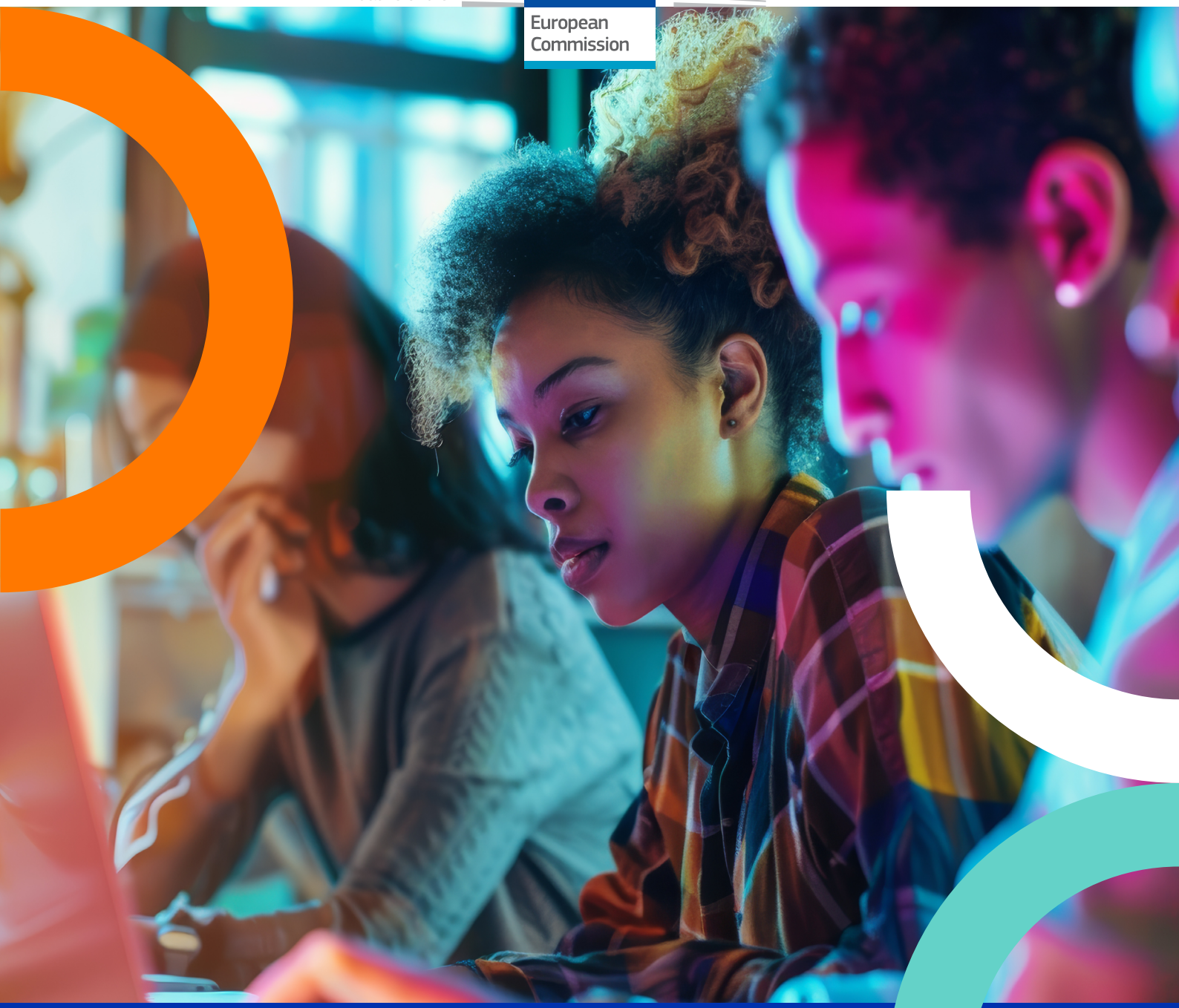

The Future Learner: (Digital) Education Reimagined for 2040

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by the European Digital Education Hub's squad

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The European Digital Education Hub (EDEH) is an online community for practitioners from all sectors of education and training aiming to contribute to improving digital education in Europe. To achieve this goal, EDEH is not only a place for exchange and discussions but also offers a variety of different events and activities. These activities include the squads that are online working groups where community members can collaborate on a specific topic of digital education. This report is the result of the work of the EDEH squad.

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Rasmus Benke-Aberg, Gül Akcaova

1 Introduction

1.1 Background

The landscape of digital education is rapidly evolving, driven by technological advancements and changing societal needs. As we look towards the future, the practice of futuring (also called "foresight") becomes essential to understand, anticipate, and prepare for uncertain futures shaped by (emerging) trends and drivers.

Often, thinking about the future is mistaken for forecasting. With the rapidly evolving environment and high-paced developments, the future of education cannot simply be forecasted like weather predictions. Therefore, futuring education was selected to start an online working group, or "squad", of the European Digital Education Hub.

Before the formation of the squad, conversations took place to scope the assignment. Futuring means actively thinking about potential or alternative futures - related to the past and present - to discover opportunities or threats. As the future of education is too broad and complex to research within six months, the main question is scoped as:

What might (digital) education look like for teachers and learners in 2040?

The squad took the year 2040 as this is far enough to allow for significant change, yet close enough to remain relatable and actionable.

This report aims to make the reader more conscious about how the possible futures may unfold and make decision-makers and policy advisors aware of the impact of today's decisions.

"Squads" are online working groups working within the European Digital Education Hub. They typically consist of approximately 25 Hub community members from different countries and different educational sectors.

This particular one was launched in August 2024 and ran until January 2025. The squad members met frequently online and worked together synchronously and asynchronously during these months.

For more information about the Hub, please visit https://education.ec.europa.eu/european-digital-education-hub.

1.2 Approach

The squad members were selected based on their experience and knowledge of applied foresight. They all had to write an application in which they motivated why they were interested in participating. The available knowledge enabled the squad to find consensus on the methodology, tools and techniques used in the exploration to investigate plausible futures.

This squad explored various dimensions of trends in digital education, including innovations in learning technologies, pedagogical strategies, and the broader implications for learners, educators, and institutions. Areas of focus included the integration of artificial intelligence and machine learning to personalise learning experiences, the rise of immersive technologies such as virtual and augmented reality in creating interactive and engaging learning environments, and the increasing importance of data analytics in monitoring and enhancing educational outcomes. The discussion also included societal and ethical considerations of digital education, ensuring equitable access and fostering digital literacy.

1.2.1 Discover and define

From September to November, the squad scanned the horizon to identify relevant trends and developments for education and for education in Europe. The squad looked for signals, evidence and patterns and eventually identified 16 highly relevant trends for education:

1. Emergence of Gen AI & virtual assistance
2. Rising need for new skills in the labour market
3. More attention to 'responsible' technology usage (flexibility, choice and equity)
4. Shrinking population due to birth rate, ageing and migration
5. Shifting from in-person to hybrid and Hyflex
6. More attention to wellbeing and mental healthcare
7. Advancements in XR (VR, AR, smart glasses) for immersive experiences
8. Budget cuts or constraints for (higher) education
9. Rise of global energy consumption and fossil fuel
10. Growing energy demand for powering AI
11. More renewables
12. Growing Protectionism in EU and (digital) sovereignty
13. Growing national conservatism/polarisation
14. Rise of geopolitical tensions
15. Europe's pursuit of inclusive economic growth
16. Global warming, extreme weather

"Horizon scanning is about staying aware of what is new or changing. The goal is to identify not just risks, but also opportunities these signals of change can generate. It allows early reflection on these developments' intended and unintended effects - the so-called "game changers" that could make a significant societal and policy impact. It aids in assessing and prioritising early signals for decision-making or further examination and analysis, relying on a diverse network of EU policy experts and some outside contributors."

– EU Policy Lab

After identifying these 16 trends, the squad looked for the most impactful trends. The trends that are selected and used in the future scenarios are the following:

1. Emergence of Gen AI & virtual assistance
2. Rising need for new skills in the labour market
3. More attention to 'responsible' technology usage (flexibility, choice and equity)
4. Shrinking population due to birth rate, ageing and migration
5. More attention to wellbeing and mental healthcare
6. Europe's pursuit of inclusive economic growth

1.2.2 Develop and deliver

When building scenarios, a common fallacy is to think of scenarios as positives and negatives or as good and bad. However, scenarios – if done properly – are a neutral description of what a future might look like. Every scenario holds a benefit and a disadvantage for its stakeholders since certain individuals have more benefit in one scenario than another scenario. Therefore, it is important to approach each scenario with an open mind and wonder who will benefit and who will not.

A common scenario approach is to combine the two most impactful and uncertain trends to form axes to construct 2x2 scenarios. However, the squad chose to adopt a holistic perspective on how the trends could play out. To develop the future scenarios, the squad used scenario archetypes . The four archetypes are identified and developed by Jim Dator[1] and applied by the squad. To prepare you for the future scenarios built and delivered by the squad, here are short descriptions of each archetype:

[1] Dator, J. & Dator, J. (2019). 'Alternative futures at the Manoa School'. In Jim Dator: A noticer in time: Selected work, 1967–2018, pp. 37–54.

- **Archetype #1 – Continuation:** This scenario usually represents the "official" view that's dominant in the ecosystem. Everything in continuation is to develop the people, institutions, and technologies to keep the economy growing. Generally, this view is strongly linked to what we see in the present.

- **Archetype #2 – Constraint/disciplined:** Constraints are often perceived as negative, limiting the field of digital learners and educators. However, they can also create opportunities for some education stakeholders, for instance, the creation of more eco-friendly use of digital resources.

- **Archetype #3 – Collapse/decline:** "Collapse and extinction" is always a possible future for any community or organisation. Communities, organisations, and cultures vanish as economic and social forces render once-valuable institutions and places unneeded or unviable.

- **Archetype #4 – Transformation:** The focus here is on the transforming power of technology – especially robotics and artificial intelligence, genetic engineering, nanotechnology, teleportation, space settlement, etc. This fourth future is called "Transformation" because it anticipates and welcomes the transformation of all life, including humanity from its present form into a new "posthuman" form, on an entirely artificial Earth, as part of the extension of intelligent life from Earth into the solar system and eventually beyond.

To ensure a holistic view, each scenario in this report has been approached from the lenses of Social, Technological, Economic, Environmental and Political (STEEP). After describing the scenario from these lenses, education is brought to life by a story to develop a better understanding of what the impact will be of the plausible future. The stories are "a day" to describe a typical day in a future. The four stories in this report are days of different personas in each scenario.

Brian Shee, Evgenia Nikulina, Roxana Voicu

2 Scenario #1 - Empowered Learning: Personalisation, Lifelong Learning, and Self-Directed Growth

In the year 2040, education is driven by advanced technologies, a culture of lifelong learning, and international collaboration. Teaching and learning are done in both physical and digital spaces, with technologies like artificial intelligence, augmented reality, and virtual reality assisting in delivering valuable learning experiences. However, these technologies have also created a volatile and uncertain working environment, where rapid change is the norm, and regulation is heterogeneous, scattered amongst regions and often just setting shallow guidelines. To address these challenges and to help prepare students, educators must integrate diverse cultural contexts, foster creativity and resilience, and promote interdisciplinary solutions to global challenges. Furthermore, highly personalised education, powered by AI, ensures learners gain the specific skills and knowledge required to make an immediate impact, whether on their careers or specific learning journeys.

This focus on lifelong learning, sustainable development, and interdisciplinary collaboration is in response to a world that, while promoting innovation and inclusion, is grappling with complex global challenges.

2.1 Factors for continuing education in 2040

2.1.1 Social Factors - Inclusive and collaborative lifelong learning focused on transversal skills

- **Adaptation in Teaching:** Inclusivity is a central pillar of education in 2040. Educators customise learning to address the academic, cultural, and social context of students. Focusing on the specific needs of individual students enhances engagement and makes education more impactful and valuable.
- **Lifelong Learning:** Due to rapidly changing job markets, there has been a global shift towards continuous education, with lifelong learning accepted as a means of achieving and maintaining success. Individuals are acutely aware of their skills and knowledge and have meticulous, and adaptable plans in place to manage their learning based on their distinct needs, interests, and environments, with the assistance of technology.
- **Collaboration:** Technology, such as real-time translation and other communication tools, has provided new opportunities for community building and networking. These are seen as a way to foster innovation, obtain diverse viewpoints, and contribute to an individual's lifelong learning journey. These collaborative environments are utilised in both industry and education, which are bound to become inseparable in the future, with life-long learning being the norm.
- **Transversal Skills:** In 2040, there is more focus on transversal skills in education and industry. This is due to advanced technologies having major impacts on most industries, leading to transversal (and very human) skills being of more value and importance to both individuals and industries.

2.1.2 Technological Factors – Personalised Learning through Immersive, Intelligent, and Data-Driven Technologies

- **AI-Powered Personal Assistants:** In 2040, individuals have AI powered personal assistants that help them with their personal life, their work life, and/or their learning journeys. There are two kinds of assistants, which may communicate with each other: provided by the educational system or school and personal. In education, educators use these assistants to personalise the learning of students, plan and adapt classes, and communicate with the class on a personal level. For students, these assistants help them manage and control their learning. This technology makes education more efficient and customised, allowing educators to focus on more creative and strategic teaching tasks, while ensuring the needs of each individual student is being met.
- **Augmented Reality and Virtual Reality:** Immersive technologies are advanced and have seen widespread adoption. They are used everywhere, across industries and social contexts. Fostered by standardized protocols for virtual spaces, advanced haptic interfaces, and improvements in network infrastructure to handle real-time sensory data exchange, these environments offer highly immersive and collaborative learning experiences. In education, simulating real-world challenges and scenarios for students encourages hands-on problem-solving and application of learning. Experiential learning bridges the gap between concept and practical application, preparing students for complex situations in a controlled setting.
- **Data-Driven Personalisation:** Data-driven personalised learning is a key feature in 2040. AI tools construct learning pathways for individuals based on their specific learning requirements, learning preferences/styles, and personal requirements and environments. This high level of personalisation minimises learner dissatisfaction and maximises educational efficiency. Although data analytics become essential, the rights of the data owner (in particular privacy) are upheld by regulation, allowing for the student to tailor the data they provide to the system for more suitable solutions.

2.1.3 Economic Factors - Lifelong Learning Investments for Enhancing Workforce

- **Global Collaboration and Borderless Work:** The world is a much smaller place in 2040 due to technology removing obstacles for collaboration and creating new opportunities for innovation. Work has also changed, with workers, in some industries, no longer restricted by location or other factors. Individuals with certain in-demand skills and knowledge often work for more than one organisation, across different countries. Advanced immersive technologies have removed many obstacles and allowed workers to take more control of their own careers.
- **Growth Investments:** While technology has created new opportunities for collaboration and work, it has also caused competition to increase significantly across the world. Following an eye-opening report by Mario Draghi in 2024 (which mentioned on page 19 that the EU "must ensure that all workers have a right to education and retraining, allowing them to move into new roles as their companies adopt technology, or into good jobs in new sectors"), Governments started to put a lot of emphasis on lifelong learning. They now invest heavily to create new learning opportunities and learning pathways, to ensure their respective workforces are skilled and well-placed to adapt to rapidly evolving industries.

2.1.4 Environmental Factors - Sustainability-driven education

- **Carbon-Neutral Operations:** Immersive technologies, including the use of avatars and holography has been embraced by industry and education in 2040 as they are seen as a way of contributing to sustainability goals (for example, reducing travel emissions). Data centres linked to educational endeavours are regulated to use solely renewable energy, so as to reduce the environmental impact of the tech usage.
- **Sustainability Themes in Education:** Sustainability issues and policies are ingrained in the practices of all industries. Educators incorporate sustainability themes into their courses so students can understand grand global challenges and be in a position to address them.

2.1.5 Political Factors - Global Awareness and Privacy-Driven Regulations

- **Geopolitical Awareness and Adaptability:** As education and work are open to the world, with technology removing many traditional barriers, there are still complex political landscapes to navigate. In 2040, individuals, whether working or learning, must have geopolitical awareness when operating across regions with diverse priorities.

- **Regulatory elements:** Following the implementation of GDPR in the late 2010s in the European Union, the regulation evolved into a framework mandating that companies and educational institutions ensure privacy by design and AI-driven personalisation to operate under stringent regulations to ensure transparency, fairness, and the ethical use of data. Added to this framework, the European Green Deal allowed for carbon-neutral data centres, so that AI in education functions in a socially and environmentally sustainable setting. However, the EU regulations are not present globally and teachers and students operate in heterogenous regulation spaces.

2.1.6 Risk Factors

- **Societal Polarization, Digital Divide, and Exclusion:** Due to heterogeneous access to the Internet across the world, there are still various regions in which education is scarce. The pace of innovation is too fast for laggard regions to catch up, so systemic inequalities are becoming more entrenched. In other regions, overreliance on AI-powered tools has decreased the capacity to think critically, and there is a diminishing level of trust in formalized education.
- **Data, cybersecurity, and ethical AI usage concerns:** The lack of global regulations may lead to unethical data usage, bias amplification, and misuse of predictive analytics to limit educational opportunities or foster educational echo chambers. A main concern remains cybersecurity, which may affect both virtual and physical infrastructure.
- **Mental health and cognitive overload:** Constant exposure to technology, by being "online", may lead to cognitive overload and burnout for both students and teachers. To the latter, another risk is related to anxiety generated by the need to continuously upskill and adapt to rapidly evolving industries.

2.2 A day in continued education

TA (they) is a 45-year-old professor, navigating a global teaching career in *Creative Problem-Solving for Risk Management*. Their institution is located in Europe, with virtual engagements in Asia. TA's philosophy is to embrace chaos as a teaching strategy, equipping students with creativity, innovation, critical thinking and resilience for a VUCA (volatility, uncertainty, complexity, ambiguity) world.

6:00 AM: TA wakes gently to an AI-driven meditation session, personalized to enhance mental clarity based on their sleep patterns, daily schedule, and preferences.

6:30 AM: TA receives the daily news digest via the smart home sound and display system and bookmarks some events to use as a future reference in class. TA brews themselves a cup of tea, and the smart pot shares insights on something related to TA's recent coursework.

7:00 AM: While having breakfast, the AI assistant provides a summary of TA's knowledge and skills along with their current levels and certifications. Being intuitive and intrinsically linked to TA, the AI assistant schedules nano-learning training sessions related to TA's profession and areas of interest.

7:30 AM: TA prepares for their day of teaching by simulating their class with AI assistance. Personalized feedback guides the creation of scenarios tailored to students' profiles: Alex, a data-driven thinker, faces conflicting reports, while Sophia, a creative strategist, innovates around resource constraints. TA brainstorms *chaos curveballs* (simulated crises) and runs the scenarios to understand the moments where students may struggle, and craft prompts that will maintain the challenge.

10:00 AM: TA's hybrid class begins. Students from around the world, attending the class onsite and online, collaborate seamlessly, aided by real-time translation. The class uses AR, VR, and AI agents to solve the case studies in a data-driven decision-making setting. AI agents adjust the data provided to the teams to simulate real-life complexities. Midway, TA introduces a chaos curveball - be it an ethical dilemma or misinformation - pushing students to adapt. The class concludes with peer reviews and AI-tailored feedback, shaping future learning pathways for the students.

11:30 AM: During office hours, TA meets students in person or online through virtual avatars to discuss their progress and provide personalised feedback tailored to their career goals. An AI assistant prepares information on each student and captures outcomes for follow-up.

1:00 PM: Over lunch, TA listens to a podcast on the latest developments in an area of interest.

3:00 PM: After a break, TA virtually lectures at Giang University, Vietnam, as part of a night course to upskill workers across industries. The AI assistant tailors the class to diverse educational levels, backgrounds, and learning styles of the students. TA blends work-based and problem-based learning, enabling students to apply new skills directly to their organizations.

5:00 PM: TA ends the teaching day with a debrief, supported by a bio-hacking device that tracks focus, energy, voice, and engagement. It also analyses TA's teaching balance - theoretical insights, guidance, entertainment elements, and feedback they provided to the students. All data feeds into their teaching portfolio aiding future preparation for classes and refining their learning journey.

7:00 PM: TA engages in a micro-credential course on "Exoplanetary Risks," offered by the European University Alliance with NASA and ESA. The course, part of their government-funded growth plan requiring three annual lifelong learning modules, is logged into their personal portfolio.

9:30 PM: Reflecting on the day's learning, TA realizes they would need to step back until tomorrow. The day ends with a personalised meditation session, designed to take TA into a deep sleep.

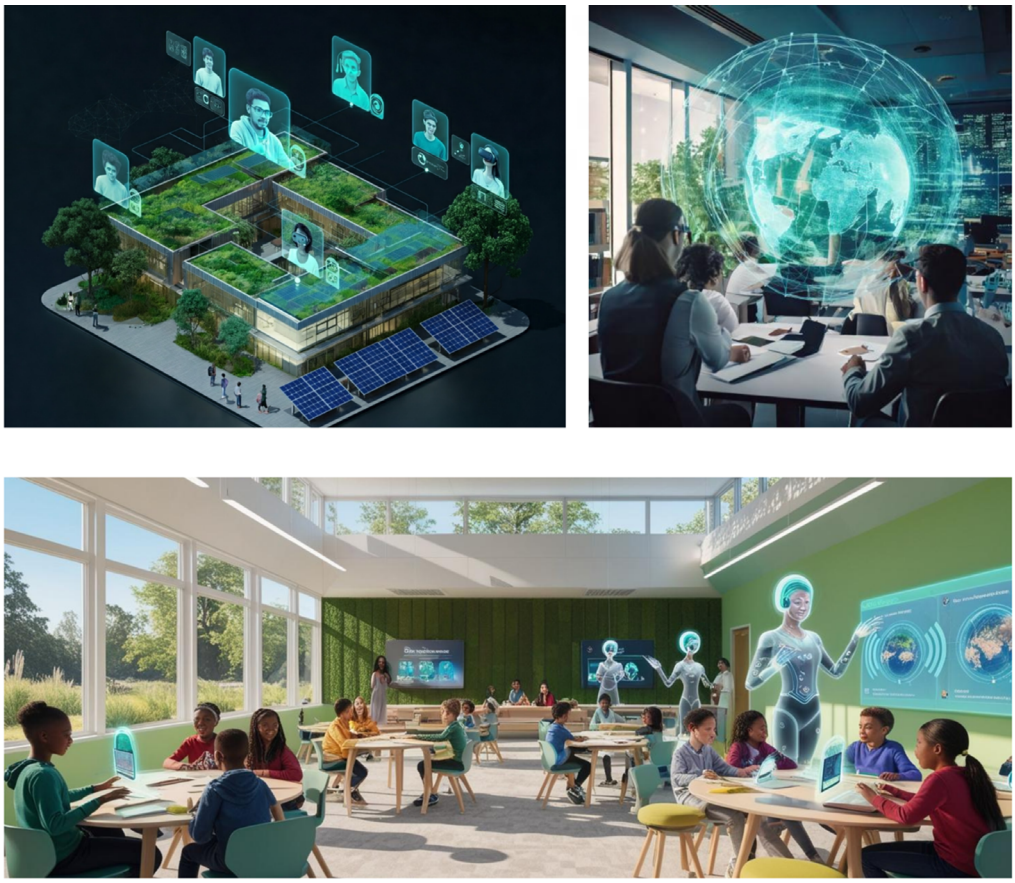

Figure 1;
Source: Created with Imagen 3 by Google Gemini (top left), Adobe Firefly (top right) and Canva Dream Lab (bottom) from the same prompt "Create an image depicting a futuristic learning environment in 2040: A vibrant blend of technology and human collaboration. Students of diverse backgrounds engage in an immersive, borderless classroom where augmented reality (AR) and virtual reality (VR) tools simulate real-world scenarios. AI-powered personal assistants guide learning, while holographic teachers facilitate discussion. Solar-powered, eco-friendly buildings integrate nature with education, featuring green walls and open spaces. A global network connects learners in real-time across continents, showcasing a sustainable, technology-enhanced vision of lifelong education and skill development." (17 January 2025)

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3 Scenario #2 - A more constrained, reasoned, and accountable framework for education

The year is 2040. The disciplinary scenario presents a campus environment where strict regulations and natural elements coexist. Education is characterised by a structured and organised approach to campus management, with campuses functioning as green, well-managed havens demonstrating a commitment to environmental stewardship. In alignment with the principles of discipline, this scenario underscores the significance of privacy and rigorous regulatory frameworks. While these elements are welcomed by some, they may not be universally accepted.

The disciplined campus is a place of rigorous order where each action is meticulously considered and where the principles of inclusivity and diversity are not merely aspirational concepts; they are the prevailing norms that shape how we live and learn on campus. The curriculum is designed following a rigorous plan established by the government, with an emphasis on addressing societal needs and promoting environmental stewardship.

The physical learning environments and the digital spaces are highly structured, with technological assistance and innovative solutions facilitating effective learning in both online and offline contexts. Learning shapes who we are, how we live together, where community, caring for the environment, and being inclusive are the main pillars of learning. All within a well-organized and watched-over environment.

Focus on controlled and managed change as our societal behaviours adapt to internal or environmental limits and often represent a refocus/new equilibrium away from an undesirable/unstainable state.

3.1 Factors for constraining education in 2040

3.1.1 A more regulated educational framework

The EU institutions and Member States have significantly intensified their involvement in the regulation of digital education, responding to growing concerns about the quality of online instruction, student data protection, and equitable access. Numerous Member States have implemented stringent regulatory frameworks that impose rigorous standards for the accreditation of online programs, data security protocols, and technological accessibility. While these measures aim to enhance the quality and reliability of digital education, they also pose challenges for innovation and flexibility within the educational sector. Institutions struggle to adapt to these evolving regulatory requirements, which can impede the adoption of new educational technologies and limit their ability to experiment with innovative pedagogical approaches. This proliferation of regulatory measures has created a complex landscape where educational institutions must navigate the delicate balance between compliance and innovation, prompting debates about the optimal equilibrium between government oversight and pedagogical freedom in the digital age.

3.1.2 A growing scepticism towards technological advancements

Many educational systems continue to struggle with outdated infrastructures, making the shift to fully digital education a slow and arduous process. Despite some technological advancements, there is a growing divide between universities with substantial financial means and a multitude of medium and small-sized universities that can't keep up, especially in remote areas and in some European regions. Many classrooms and lecture halls remain stuck in the past, focusing on the heritage and historical character of the infrastructure, with a notable lack of investment in cutting-edge equipment (European Commission 2024a). Faculty training programs are still insufficient to equip educators with the skills necessary to effectively use emerging technologies. Digital culture has done more to encourage digital individualism than online collaborative processes, which remain complex for technical, cultural and human reasons. Collaborative work remains largely individualistic and fragmented, hindering the digital transformation from reaching its full potential (Van der Swaan, 2017). It is more and more difficult to build up new school exchanges and twinning arrangements and alliances between universities, because of the complexity of the procedures and the diversity of the stakeholders, who are still struggling to see the point of changing scale.

3.1.3 Less inclusion and technological equity in digital learning

A large portion of the global student population still faces significant barriers to accessing digital education. The digital divide is more pronounced than ever, with students from disadvantaged backgrounds, remote areas, and those with disabilities struggling to access essential learning tools. In addition, students who are reluctant to engage with technology, and who lack the skills to use digital platforms are left behind. Educational institutions have not sufficiently addressed these inequalities, and many students still lack reliable internet access from home, modern devices, or digital literacy skills. As a result, the promise of digital learning has not been fully realised for a large segment of the population (Zgaga, 2006; CFoE, 2022).

3.1.4 An emerging threat to the quality of digital education

The online landscape is flooded with AI-generated content, but much is of low quality. This forces the few quality publications and educational content to be increasingly precise and beneficial, at the risk of sometimes being technical and difficult to read, and they engage in a race for excellence. Many online courses are designed with flashy graphics and special effects but lack the depth and rigour required for effective learning. It is difficult, to trace the origins of the site because of the vast amount of content created artificially by AI. There are still no universally accepted standards for quality assurance in digital education,

and many online courses fall short of traditional face-to-face education in terms of content and educational outcomes (Curaj, 2020). Curriculum designers are struggling to keep up with the rapid pace of technological change. Teachers are finding it increasingly difficult to select the right content and verify the reliability of its sources. This leaves many students questioning the value of digital credentials, especially if the learning experience does not meet their expectations or needs. A very selective process has been put in place by governments and academia to avoid the proliferation of fake sources (EFEE, 2024).

3.1.5 A more sophisticated approach to training in digital literacy

The digital skills gap among teachers is still a major barrier to the effective use of technology in education. Under the pressure of the labour market, students have become highly specialised in digital technologies but are losing essentials like collaboration, critical thinking, and emotional intelligence. The job market, however, demands versatile individuals with broad skill sets. While technology has advanced rapidly, educational systems have prioritised technical training at the expense of nurturing these fundamental abilities. As a result, graduates are often ill-prepared for the complexities of the post-industrial job market, where flexibility and cross-disciplinary collaboration are key. While students are becoming increasingly proficient with digital tools, many educators remain less comfortable and fluent with these technologies. The lack of comprehensive and continuous professional development programmes for teachers in digital tools and pedagogies continues to hinder the integration of technology in the classroom, leading to missed opportunities for innovation in teaching and learning, unless they have taken one of the new innovative digital training courses that are on the increase (CFoE, 2022, European Commission 2024b).

3.1.6 Student engagement and motivation in virtual environments

Students still struggle to remain engaged in virtual learning environments. Digital tools have evolved into platforms primarily designed for entertainment rather than education, and as a result, students often approach online learning with a casual attitude, equating it to leisure rather than serious study. This cultural gap, coupled with the lack of research-based insights into digital engagement, means that many students are not benefiting from the latest advancements in educational psychology and digital pedagogy. The result is a growing disconnect between the potential of digital learning and its actual effectiveness in motivating and retaining students. There is a growing trend in the provision of courses designed to facilitate reconnection with the natural environment, reading, and spiritual practices. These courses are becoming an alternative to traditional spiritual retreats.

3.1.7 Assessment and accreditation of digital learning remains a significant challenge

Automation has led to a simplification of correction procedures, which has saved time, limited errors and personalised responses, but has standardised tests, reduced the complexity of problems and limited human interaction. Teachers and institutions are still struggling to develop effective methods for evaluating students in virtual environments. In addition, the rise of digital fraud - cheating and credential manipulation - has led to a devaluation of online degrees and certificates. Many digital credentials are not recognised or respected internationally, raising concerns about the integrity and credibility of digital education. As the demand for digital learning grows, the lack of standardised, reliable assessment and accreditation mechanisms continues to undermine its value. Concurrently, two forms of assessment are in operation: a rapid, user-friendly digital skills assessment in the form of a Flash-based questionnaire, and a more conventional assessment for specific subjects.

3.1.8 Data privacy and security

The misuse and leakage of personal data online remain pressing concerns for the education sector. The multiplication of authentication procedures has been simplified in favour of the use of unique and secure encrypted identifiers. Despite advances in digital security, incidents of data breaches and the misappropriation of student information have become more frequent. These breaches have led to tighter regulations and restrictions on the use of personal data, but the education sector still struggles to protect sensitive information adequately. The growing awareness of cybersecurity risks has prompted institutions to adopt new strategies, such as the use of digital personas or doubles, to safeguard student privacy and mitigate the impact of overexposure online.

3.1.9 Scalability of digital learning models

The scalability of digital learning models has become a key challenge. While some digital education models work well in small, controlled environments, scaling these models to accommodate large and diverse populations has proven difficult. The technological infrastructure in many regions is not always sufficient to support large-scale online education, and the pedagogical methods used in smaller settings often do not translate effectively to mass education. Additionally, institutions face logistical challenges in delivering high-quality, personalized education to a growing number of learners. As a result, many digital learning platforms struggle to meet the demands of an increasingly global and diverse student body. Only massive investment, from both the public and private sectors, and from individuals, who are more aware of the central role of science and digital education, has made it possible to raise massive funds to support large-scale projects.

3.1.10 A more responsible use of digital resources

The educational landscape is deeply influenced by the environmental impact of technology. Universities worldwide struggle with the extensive energy consumption of advanced digital tools, leading to strict energy-use policies that limit the operation of high-tech equipment. This necessitates a blend of traditional and carefully rationed digital teaching methods to balance educational needs with environmental responsibility. The divide between well-funded universities[2], which can afford energy-efficient technologies, and those with limited means, relying on outdated systems, is stark. The integration of sustainable practices into the curriculum at the global level is a necessity, as it allows students to gain an understanding of the importance of conservation alongside their academic studies. Nevertheless, a negative and challenging trend has emerged with the advent of private tycoons who are funding universities without any environmental or societal constraints. This dual focus on education and ecological sustainability defines the daily reality of learning and teaching, shaping policies and practices across institutions (EDUCAUSE, OECD, UNESCO, 2023).

[2] This is, of course, a bit of a simplification. There could also be well-funded universities who are not interested in the environment (e.g. from authoritarian regimes).

3.2 A day in a constrained education

Scene: *A futuristic campus with limited use of digital resources. The campus has a blend of traditional and digital elements. There are solar-powered classrooms, digital boards, and a prominent building labelled "Europeana," a temple dedicated to real books and sources.*

Leo and Emma are school pupils; TA is a teaching assistant.

Leo: (tapping his tablet) Wow, this campus is so cool!
But this thing won't stop asking for my "bio-consent" every time I log in. Do they think I'm a lab experiment?

Emma: (*snickering*) Welcome to *Digital Education 2040*! I hope you ticked all your data privacy boxes, or your profile's probably floating around the dark web for kids.

TA: (*chuckling*) Be glad it's just your profile. Last week, I downloaded a "peer-reviewed paper" for my seminar. Turns out, it was an AI-generated fake. Even our top-tier verification software didn't catch it.

Leo: How'd you find out?

TA: Well, the author was supposedly "Dr. Bot Lovegood," with citations from *EDEH Weekly*. My students thought I'd gone mad!

Emma: Classic TA. But seriously, isn't your software supposed to be cutting-edge?

TA: (*sighs*) It is! But the scammers are always a step ahead. That's why I tell my students: "trust but verify... with extreme scepticism".

Leo: Speaking of scepticism, why do I have to keep learning about these "sustainable tech devices"? They lag worse than Grandpa's stories about pre-digital classrooms!

Emma: (*rolling her eyes*) Budget cuts. Our school's energy quota barely powers the holographic boards. And don't get me started on the rationed VR simulations. I wanted to explore ancient Rome last week, but we only had five immersive minutes before the system shut down.

Leo: Five minutes? That's more than we get. My school banned VR altogether after someone used it to "re-live recess" for six hours straight.

TA: Energy limits are a big issue everywhere. Universities and schools must justify every watt. My classroom doesn't even have proper AI tutors anymore—too power-intensive. Looks like we're back, at least partly, to good old-fashioned human lectures.

Emma: Have you been to Europeana? It's a temple dedicated to real books and sources. You can read and discuss with real people. Sometimes, the best innovation is going back to the basics. Let's make a spiritual retreat to Europeana. It'll be good for all of us.

Leo: (*giggling*) Emma's right, but seriously, can't they sort this out?

TA: Well, they're trying. There's this new initiative to develop low-energy tech and combine it with real-world activities. They call it the "Green Hybrid Model."

Emma: Sounds fancy. What does it mean?

TA: It means we're planting trees while learning about carbon offsets. Real saplings, not virtual ones.

Leo: I like it! But what about exams? My brother says the new flash tests are like playing a video game.

Emma: True. They're quick and kinda fun, but I still prefer old-school projects. They let you actually think.

TA: Exactly! We need to balance innovation with critical skills. That's why I'm hosting a debate next week on "Human Intelligence vs. Artificial Assistance."

Leo: Oooh, can I join? I'll argue that humans rule...with a little AI help.

Emma: I'll argue against you—team AI all the way! The latest version of Mistral is just amazing!

TA: Perfect. Just promise you won't use fake sources. And Emma, don't let Leo's hologram argue for him.

Emma & Leo: Deal!

They all laugh, as the holographic campus bell signals the end of their break. The scene fades, hinting at hope and collaboration despite the challenges of the digital age.

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4 Scenario #3 - The end of human knowledge and digital education?

By the year 2040, society as we know it has collapsed (declined). Due to a lack of appropriate legislation and an overoptimistic faith in techno-solutionism, the evolution of technology has become uncontrollable. Neither governments nor tech companies have been able to overcome the inherent self-destructive elements of technology, specifically AI, which, by 2040 has become self-referential (Csernatoni, 2024). This means that AI systems have developed and evolved within the constraints of their systems, relying on information the AI systems have themselves produced, leading to the loss of human knowledge, relevance and trustworthiness. It is no longer possible to determine and distinguish human-created information from that created by AI systems, and AI systems are constantly and rapidly making up new information that cannot be fact-checked, researched or verified. This has turned out to have drastic implications for digital education, knowledge creation and scientific progress. Last but by no means least, the climate impact of such massive recourse to technology can no longer be ignored.

4.1 Factors for declining education in 2040

The main key issues contributing to this decline are as follows:

4.1.1EU regulations are no longer fit for purpose

While the EU initially set the global benchmarks, the so-called “Brussels Effect” has revealed its limitations: Europe cannot regulate on behalf of the world. The slew of digital laws, while robust on paper, lack the adaptability and enforceability measures to control cross-border data flows and rapidly evolving technologies. Ambiguities around risk classification exacerbate the problem, creating a patchwork of accountability measures. Biometric and behavioural data are still collected, processed, and repurposed without sufficient oversight and quality control.

4.1.2 Legislative loopholes undermine privacy, public trust, and innovation

The increasing reliance on AI in education exposes critical legislative loopholes, allowing private corporations to access sensitive learner data under the guise of providing “free” educational tools. At the same time, governments and the educational sector find themselves overwhelmed by an avalanche of digital laws and regulations. With limited resources and expertise to navigate complex compliance frameworks, confusion

reigns. As a result, the oversight of educational AI systems is often outsourced to private corporations under the guise of efficiency, creating a glaring conflict of interest. Corporations, rather than governments, increasingly dictate how data is collected, processed, and commodified, prioritising profit over public interest. Despite the European Union's regulatory ambition, policymakers have failed to safeguard against emerging risks, leaving gaps that erode privacy, trust, and innovation. Parents are demonstrating and teachers are going on strike to protest the use of these tools.

4.1.3 Science drowns in AI-driven fraud

Science gets flooded by AI-created articles with results that are increasingly questioned: by 2040, the hopes that AI would bring about new progress in science have been dashed, in the face of lowered quality across the board. Articles are spewed out by text generators and digital twins have turned out to be cheap and imprecise substitutes for real experiments. This did not bother the public until medicine began to be much less efficient and with many more unforeseen side effects. It turns out that the medical industry has been using low-quality synthetic data in AI-based drug discovery for over a decade, with predictable effects.

4.1.4 The two-tier education system: inequality by design

Partnerships between EdTech companies and educational institutions further blur the line between public interest and private profit. These collaborations often result in co-drafted codes of conduct that favour market-driven agendas. A **two-tier system** emerges in which public education, fully digitalised and profit-oriented, contrasts sharply with private education, where "safe data spaces" remain exclusive to the wealthy elite. Public institutions increasingly lose control over their digital infrastructure, reinforcing systemic inequalities and leaving vulnerable learners exposed.

4.1.5 The cyber-attack time bomb: data spaces at risk

The EU's focus on data spaces—shared repositories promoting innovation and data collaboration—introduces new vulnerabilities. While intended to support collective progress, these repositories have become prime targets for cyber-attacks. In 2035, a European data space was compromised by cyber-attacks resulting in the irreversible loss of research data, learner profiles, and institutional infrastructure. Policymakers fearing further destruction make a public statement: "We will not do this again." The destruction of trust in these shared systems has stymied progress, amplifying caution and fear rather than innovation.

4.1.6 It is no longer possible to differentiate between AI and human-generated content

In 2040, an extreme amount of information is released every moment, and it has become increasingly difficult to discern what information can be trusted. With no hard facts to check for reliability, apathy sets in, leading many to question, "Why should we waste our time on knowledge?" As central open science frameworks and traditional databases have disappeared, it has become impossible to know what is real and what is fake.

4.1.7 The expert community has all but disappeared

As the notion that "everyone's an expert" proliferates, the traditional expert community has significantly diminished. Consequently, experts, academics, and other knowledge stakeholders have ceased to conduct their original research.

4.1.8 "Who is Who?"

Due to the advanced capabilities of AI systems, most citizens have acquired an 'AI Self' that they use to communicate on their behalf. This technology was launched by MIT as an evolution of their Future You platform (MIT, 2024). The AI Self has become an extension of the human self for many citizens, who use it in their day-to-day communications with family, co-workers, organisations and others. Much like a human develops their personality over time, so does the AI Self, though much faster. It comes pre-set with a person's preferred characteristics and personality traits, knowledge of the human which it is extending, and within only a few hours, it can be trained to seamlessly act, communicate and make decisions on behalf of the citizen. The downside of the evolution of the AI Self systems is that no one knows if they are interacting with a person or the person's AI Self. This has led to diminishing human contact and conversation.

4.1.9 Academics use AI to create teaching material

Due to the extensive availability of AI platforms, tools and software, most university academics have given up on creating their own original content, lecture material, assessments, and exercises. Instead, they generate this content with AI. Based on a recent survey of university academics across Europe, this has led to a drastic decline in enthusiasm and enjoyment among educators, who feel more like they are working in a factory than in an intellectual environment, filled with curiosity, experimentation and independence of thought.

4.1.10 Climate disruption is at a breaking point

Storms, flooding, droughts and extreme temperatures are now the norm, and despite AI-fuelled misinformation that continues to deny the causes originating in our overreliance on technology, few can ignore that the trends already noted over several decades have been exacerbated by the massive amounts of energy and water required to run AI systems (Hacker, 2024).

In the face of these extreme challenges, there has been a major shift in the way humans consider the role of knowledge and education in society, leading to:

- **A stronger focus on skills and practical competencies.** In 2040, knowledge alone is no longer sufficient to showcase a student's capabilities. There is an increased focus on skills and practical competencies. Emphasis is now placed on the tangible, 'human' skills that individuals can demonstrate and evidence. Moreover, dealing with climate change requires humans as workers for massive infrastructure projects to protect the land.
- **An emphasis on life skills – self- and community-reliance.** As populations shrink and age, there is a critical need for people in sectors that do not require academic skills. The care sector and construction are particularly hit, as tasks here are difficult to automate. Employability is no longer an incentive to go through higher education.

4.2 A day in a declined education

To illustrate this, here is the last ever blog post from Rosa, a university student who has just made a huge decision. Rosa has posted this on the platform, 'Humans Only'.

"From digital to human reliance"

Hi all, this is going to be my last post here - or anywhere for that matter. I am joining the others and switching off. I no longer know *who* is real and *what* is real. I simply miss living in a human world. If anyone wants to talk, you have my number (those of you who care about human conversation and connection).

As part of switching off, I have also decided to drop out of university even though I have not finished my degree yet. This is much more deep-felt than just switching off my AI Self and disconnecting from the digital and virtual environments. After the latest revelations that prove that everything we are learning in class from our professors, the academic articles we read, and the information we receive from news media are all created by AI and based on information that AI systems have created themselves, I see no reason to waste any more time trying to finish my university degree as it is all fake anyway. Every day I observe how my professors are unable to disentangle themselves from this mess created by AI.

As I have been living in a digital world for so long, I do not have any practical skills (I can't even keep a plant alive!). I looked for apprenticeship opportunities and I am excited to share that I started as an apprentice farmer one month ago at the "Farm to Fork"[3]. This is a place where like-minded individuals from across all walks of life have decided to come together to escape the destructive impact that AI systems have created, pushing aside human conversation, connection and community. Here, people thrive in their analogue lives and seek to live and learn without any reliance on digital technology. They work together to build up new knowledge based on local needs. In the absence of digital connectivity, people are seeing an opportunity to create a very different learning environment that prioritises humans, human collaboration, human connection and building communities of self-sufficiency.

Please do not misunderstand me. It is not about reverting to the 'dark ages' or recreating a 'golden' time before technology. No, it is about helping people to become more self-reliant, reconnecting with nature, and finding happiness in social connections – something that we almost lost. In my view, these core aspects of life had become suppressed in mainstream society as everything 'digital' and 'virtual' took the lead. It was so obvious that everyone looked to technology for the truth, for improvements and for solutions. Everyone thought that we could solve the climate crisis with more technology, and more AI, but not many spoke of the disastrous environmental impact these technologies also have on the environment, people and communities. Instead, everyone just wanted more, more and more.

I am absolutely loving my time here at Farm to Fork. Here, we use new approaches to developing decentralised, resilient and future-focused microgrids for secure, stable, and localised energy production. We have accelerated food production methods and pioneered new methods of regenerative farming. We have significantly increased social connections, feelings of belonging and well-being. It feels really good to be learning practical skills in the 'physical world' after so many years of mainly being present in virtual spheres.

Yesterday, I spoke with one of my mentors and he told me that many of his colleagues from the mainstream society and educational institutions have now joined him here at Farm to Form. They have also had enough of what they refer to as a 'fake', non-human society created by AI. In fact, there is a general exodus from these traditional universities to new alternative professions and ways of life where people seek to reconnect with humans and information they can trust. When I speak to my fellow students, they are also enjoying the philosophy and teaching style at Farm to Fork. They enjoy the hands-on and practical learning they are engaged in. We have had many young people from the traditional mainstream universities join us, just in the last week. They have come to reconnect, rebuild trust in what we know, and have genuine conversations with real people, not AI Selves.

[3] Note: this imagined initiative is not to be confused with the official EU strategy with the same name

In 2040, living in a more analogue and 'digital-by-choice' way is now seen as a healthier way of life. Many people have seen their mental well-being improve, acquired new skill sets, and value human relationships more than previous generations. Many feel that learning to live, work, collaborate and connect without 24/7 digital reliance has given them a better quality of life.

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Figure 2;

Source: Created with Copilot on by Dr Rikke Duus from the promt: "Create an image of a future place focused on the theme of "from farm to fork". The images should show people engaged in different activities and have a sign that says Farm to Fork and look futuristic. The focus of this place is on human connection, belonging and traditional self-sufficient activities and skills that create enjoyment and a sense of freedom. The image should also showcase groups of people growing their own food through vertical farming and other future-focused methods." (9 January 2025)

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5 Scenario #4 - A transformative vision

Transformation in education refers to profound, systemic changes in how education is designed, delivered, and experienced, aiming to achieve better outcomes for students, educators, and society. This process goes beyond incremental improvements and seeks to fundamentally rethink and reshape educational systems, practices, and philosophies to meet current and future challenges. Transformation in digital education for 2040 focuses on equity, relevance, innovation, and adaptability being related and shaped by larger societal changes, technological innovations and organisation of learning. This in the context of deeply human and social experiential learning, as we have come to understand that technology supported learning has its limitations in the holistic journey of human learning.

5.1 Factors for transforming education in 2040

5.1.1 Societal Trends feeding Transformation

By 2040, education will focus on being an experiential path where the rote and cognitive learning is taken over by technology supported processes and the augmented focus of education aims to foster a socially aware, resilient, empathetic, and adaptable global society. It will evolve into a lifelong, holistic journey aimed at preparing individuals for a rapidly changing world, with technology enhancing rote and cognitive learning on the one side via personalized tracks accessible to all and on the other in increasing the human experience in education as the understanding has grown around the importance of social learning. This of course grounded in ethics and privacy.

5.1.2 Humanity and Society – National vs Global; Content vs Skills & Attitudes

By 2040, education will emphasize empathy, critical thinking, emotional intelligence, and practical skills alongside intellectual growth. It will re-evaluate human emotional and social skills and recalibrate their value in the educational process as a means as well as a goal. Schools will celebrate cultural diversity, fostering mutual respect. Students will be seen as global citizens, embracing roles in protecting the environment, promoting fairness, and contributing to peace, preparing for a sustainable future.

5.1.3 Environmental – Ambiguity vs deep Connection with Environmental Issues

In 2040, sustainability is central to education, with lessons on climate science, renewable energy, and responsible consumption. Students apply these topics in real-world scenarios, making sustainable choices. Learning environments include outdoor labs and virtual reality, creating immersive experiences. This blend of hands-on and digital learning fosters a deep connection to environmental issues, preparing students to tackle global challenges responsibly and creatively.

5.1.4 Geopolitical – Local vs Global Awareness

Education in 2040 emphasizes civic engagement, providing insights into governance, international relations, and global challenges like migration and public health. Combining theory with practice, students explore systems of power through role-playing and simulations, gaining hands-on experience in empathetic diplomacy.

5.1.5 Well-being – Pure Performance vs Balance

Education goes beyond the classroom and guidance and well-being is offered 24/7 every day. The journey of learning is considered constant and the guidance offered focusses on the balance between performance and both mental and physical well-being, integrating mindfulness, resilience training, and stress management into daily activities. Physical and mental health is prioritized through active nudging and the quantified self, with lessons on nutrition, sleep, and healthy habits.

5.1.6 Lifelong Learning - Fixed vs Flexible-oriented Mindset

In 2040, education fosters lifelong learning and adaptability, meeting evolving needs. Learning is an integral part of everyday and is no longer seen as a separate activity, nor one which is ever finished. Flexible pathways like modular degrees, micro-certificates, and competency-based programs offer tailored reskilling. Through a monitoring of activities, suggestions for behavioural and cognitive learning activities are offered daily. This keeps education relevant in a fast-changing world. Blending flexible structures with future-focused training prepares individuals to succeed professionally and thrive in a world of constant transformation.

5.1.7 Technology - Interdependence vs Confident Integration

Technology bridges gaps with AI tutors, simulations, and personalized platforms, enriching education while celebrating human interaction. Students learn ethical tech use and reflect on its societal and environmental impacts. Digital literacy focuses on successfully interacting with and managing AI, recognizing misinformation, responsible social media use, and data privacy. Accessibility is prioritized through inclusively designed tools. Understanding system interoperability fosters collaboration and innovation.

5.1.8 Technologies, Techniques and Tools Shaping the Future

A set of technologies, techniques and tools, some significant examples of are listed hereafter, will act as transformation drivers / accelerators shaping the 2024 Digital Education landscape. The combination and the synergies of these components, as well as the level of their individual adoption, will create a digital ecosystem not only able to relevantly answer the societal trends mentioned above, but also to support the learning organization described below.

- New Generation Digital Learning Environments (NGDLE): AI-powered Learning Management Systems (LMS) platforms that offer personalised learning paths and seamless integration with other digital tools.
- Immersive technologies (XR): Virtual, augmented and mixed reality will provide interactive, hands-on learning experiences.
- Neural Interfaces: devices that establish a connection between the nervous system and external systems, enabling the monitoring and regulation of signals to specific areas of the nervous system to optimize cognitive and affective functions.
- Gamification: Playful elements will increase student engagement and motivation.
- Mobile Learning: Wearable devices with voice control and mixed reality capabilities will redefine access to information.
- Advanced Infrastructure: Robust internet and powerful hardware (e.g. quantum computers, nanobots) including Internet of Things (IoT) will ensure equitable delivery of educational resources.
- AI innovations: From automating administrative tasks to global connectivity, AI will revolutionize the way education is delivered and experienced.

5.1.9 Learning Organisation

The European education system will be transformed into a Competence-Based Education Framework with Multi-modal access to education (in different regions or institutes, through different education channels and with different education technologies) and common certification standards based on standard majors and flexible Micro credentials linked to the aligned Competence-Based Education Framework gathered in a Common/Global Degree/Diploma.

- **Multi-modal access:** By 2040, education will focus on flexibility, adaptation, and targeting societal trends. Most universities will adopt multimodality in course participation, offering face-to-face, synchronous, and asynchronous distance learning. This HyFlex configuration will allow attendees to switch modalities based on their needs, ensuring equivalent outcomes. Supported by a technological

ecosystem (AI-powered LMS, XR, Mobile Learning, Advanced Infrastructure), seamless integration of physical and digital environments will create an optimal personalized learning experience.

- Micro-credentials: Modular and competency-based curricula provide learners with the option to tailor their education to personal goals and emerging skills, while also recognizing achievements at various levels through micro-credentials. However, there will be still offer of long study programs- Students will also have in this long study program options to personalise their learning pathways, through personalised contents which will be based on learning analytics.

5.2 A day in a transformed education

This section presents three scenarios illustrating what a Learning Day in 2040 could look like. It offers perspectives from students, teachers, and explores how technology will shape and enhance the learning experience.

5.2.1 A day in students' life in 2040

In 2040, a typical school day will be both immersive and personalized. Students begin their day by reviewing a digital dashboard, which includes personalized learning goals and tailored activities that align with their unique strengths and interests. AI tutors support students through real-time feedback and customized content, adapting to each student's pace and ensuring no one falls behind. The day is filled with hands-on collaborative projects using extended reality (XR) simulations, where students work with peers and teachers. Students can learn in different environments (schools, learning hubs, outside, online/XR) based on their curriculum, learning profile (age, social and experience background).

Throughout the day, students also participate in wellness activities, including mindfulness exercises and short physical activities tailored to boost both mental and physical well-being. By evening, their learning progress is visualized, and feedback is sent to both students and (parents), creating a continuous loop of learning and growth.

5.2.2 The teachers' role in 2040

Teachers in 2040 will transform into mentors and coaches focusing also on well-being of learners., with AI supporting routine tasks like producing assessment resources and performing administrative work. Teachers perform less administrative tasks. These are all integrated in the information systems used to transfer data. Teachers can focus on using multimodal technologies (see above), creating engaging learning environments, fostering critical thinking, and nurturing each student's development. Their role includes providing personal

attention to motivate students guiding them in collaborative projects, cultivating social and emotional skills, and supporting intercultural understanding through global partnerships.

As facilitators, they champion holistic education, from ethical tech use to environmental awareness, and help students build competencies for lifelong learning.

5.2.3 Usage of EdTech in 2040

Educational technology in 2040 will be seamlessly embedded in all aspects of learning. Learning systems go beyond the morning to afternoon school day, becoming more holistic and seamless. Social, emotional and behavioural growth has become an integral part of the education system as our human attributes are celebrated more in the light of technological advances. Adaptive learning platforms use AI to provide real-time feedback, continuously adjusting learning pathways to individual needs and preferences. Input and feedback are augmented with the use of neural devices, making the learning loop a seamless one with emotional and social guidance from teachers. Immersive tools like VR and XR allow students to engage with complex subjects in an interactive way, enabling experiential learning through virtual simulations.

AI systems enhance global connectivity, translating languages in real-time and fostering cultural exchanges in virtual classrooms. EdTech supports a modular, micro-credential-based curriculum, making education highly flexible and customizable to each student's career goals. Privacy and ethical considerations remain a priority, with advanced data protection ensuring student data is securely managed. This technology-rich environment not only personalizes learning but also prepares students to thrive in a globalized, digitally driven world.

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