European Education Area Strategic Framework

Working Group on Digital Education: Learning, Teaching and Assessment

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Input paper: Emerging technologies and related educational practices

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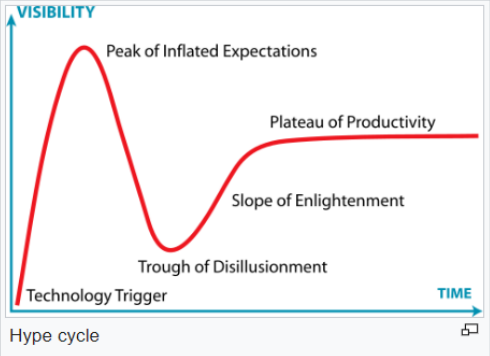
What are seen as emerging technologies in education will change from year to year, and from country to country, and even from school to school. The Gartner Hype Cycle is frequently used to represent the main stages of the adoption of emerging technologies and provides a warning as what to expect as an emerging technology begins to be used.



Sometimes a technology emerges at one time, then ceases to be widely used before re-emerging later, for example blended learning and virtual worlds (e.g., Second Life) were emerging technologies 15-20 years ago, but re-emerged (the later in the form of the Metaverse) in recent years.

There are many proposals as to what might count as an emerging technology in education at the present time, and we'll list some potential candidates below. However, **it is not the technologies per se that are of most interest**, **but rather the emerging educational practices and pedagogies that are supported by these technologies, and so we will also comment on those emerging practices**. Nevertheless, there is some potential value in also keeping track of emerging technologies in themselves, so that education is not taken by surprise by disruptive technological developments.

The 2018 report 'Artificial intelligence and emerging technologies' from the University of Newcastle, Australia[1], identified three emerging technologies: artificial intelligence (AI), virtual reality (VR) and augmented reality (AR), and discusses associated educational practices. These three technologies are the ones most identified amongst the variety of reports we examined.

The 2020 report 'Digital Learning Innovation trends' from the Online Learning Consortium[2] identified a range of technological trends including: MOOCs, LMS and interoperability, open education resources, virtual reality, and artificial intelligence as well as related educational practices including: adaptive learning, gamification and game-based learning, and blended learning.

The 2023 EDUCAUSE 'Horizon Report, Teaching and Learning'[3] identified three technological trends: the potential for AI to become mainstream is growing: the online versus face-to-face dichotomy is being disrupted, low- and no-code technologies that simplify complex processes are enabling more people to create digital, and three trends related to educational practices: Student demand for flexible and convenient learning modalities is increasing, the focus on equitable and inclusive

[1] https://apo.org.au/node/254301
[2] https://files.eric.ed.gov/fulltext/ED603277.pdf
[3] https://library.educause.edu/resources/2023/5/2023-educause-horizon-report-teaching-and-learning-edition

teaching and learning has expanded and intensified, microcredentials programs are gaining momentum and maturity.

The 2022 report from Education Scotland 'Emerging technologies, emerging practices in education'[4] identified a range of emerging technologies including: virtual reality, augmented reality, mobile learning, artificial intelligence, learning analytics, 3D printing, live streaming, learning games and simulations, wearable technologies, massive online open courses, robotics, and drones. The range of emerging educational practices included: streaming of live lessons, accessing recorded lessons, collaborative learning, supporting learning through social media, learning in immersive virtual environments, hybrid learning, game-based learning, mobile learning, and the use of open education resources.

The mention of wearables[5] in this report is an interesting addition to the list of emerging technologies. There are a wide variety of educationally valuable uses of wearables[6], but the strong pushback that took place in 2017 against the use by BrainCo of headbands to measure students' attention levels[7] perhaps illustrates how the use of emerging technologies in education needs to be **appropriate to the context,** not simply novel.

Erasmus+ projects using emerging technologies

Using the database of Erasmus+ projects[8] we carried out a search on 'emerging technologies' for schools and VET but excluding HE. Whilst many projects mentioned emerging technologies, they tended to use the term in a very general sense, often synonymous with 'digital technology'. The annex to this paper lists a sample of nine projects which described specific emerging technologies. AR (Augmented Reality) was mentioned five times, VR (Virtual Reality) four times, 3D Design three times, AI (Artificial Intelligence) twice and there was one mention each for: Web 2.0, Building Information Modelling, Robotics, Graphic programming, IoT (internet of things) and 3D Printing. However, simply searching for 'emerging technologies' did not uncover all relevant activity. For example, by searching for specific technologies we also identified projects using Geographical Information Systems (GIS), GPS and Geo-caches, Drones, wearables and Blockchain, and yet none of these were described as 'emerging technologies' in the project descriptions.

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[4] https://education.gov.scot/improvement/research/emerging-technologies-emerging-practices-in-education/#:~:text=An%20emerging%20technology%20is%20one,improvements%20in%20learning%20and%20teaching

[5] Wearable technology is any technology that is designed to be used while worn for examples smartwatches and smartglasses.

[6] W. Gao, T. Wei, H. Huang, X. Chen and Q. Li, "Toward a Systematic Survey on Wearable Computing for Education Applications," in *IEEE Internet of Things Journal*, vol. 9, no. 15, pp. 12901-12915, 1 Aug.1, 2022, doi: 10.1109/JIOT.2022.3168324.

[7] https://www.edsurge.com/news/2017-10-26-this-company-wants-to-gather-student-brainwave-data-to-measure-engagement

[8] https://erasmus-plus.ec.europa.eu/projects

Conclusions

There is a wide variety of emerging technologies and of emerging educational practices drawing on these technologies. There is a need for horizon scanning to establish what new technologies are being developed that may have implications for education (either in terms of new content that needs to be taught, or in changed educational practices to take advantage of the new technologies) so that educational institutions are not taken by surprise. The development of emerging educational practices related to these technologies will always require a period of experimentation and evaluation to refine approaches, and so there needs to be a differentiation between supporting already well-established technology use in education and preparing for the more experimental use of emerging technologies.

Questions to consider

- What do you think are the most important (or relevant) emerging technologies, and associated educational practices in your context? Which ones are most promising?
- What can be done to identify promising emerging technologies, and associated educational practices? What role might Erasmus+ play here?
- How should a Member State, or perhaps a school, go about the process of identifying and implementing emerging technologies, and associated educational practices, when (perhaps by definition) there is little of existing good practice to show the way?

ANNEX: Example Erasmus+ projects using emerging technologies

Name, link	From the project description	Tech
Digital technology, Imagination, Creativity and Entrepreneurship for a high quality teaching 2020-1-ES01-KA226-SCH-094966	We will promote the use of emerging technologies such as VR / AR, 3D design, APPS...it aims at transforming the project students from passive users to creative and conscious creators of knowledge and information, they become architects of their own learning	VR AR 3D Design
FAiry TAle Science Augmented 2019-1-IE01-KA201-051391	Supporting distance learning through an AR learning methodology and mobile application for science subject;	AR
PROMOTING TEACHERS' PROFESSIONAL DEVELOPMENT AND INCLUSION THROUGH THE INTEGRATION OF EMERGING TECHNOLOGIES IN THE TEACHING OF CHILDREN WITH AUTISM 2022-1-PL01-KA220-SCH-000086733	The main activities refer to the design, develop, pilot-test and promote an interactive VR Game addressed to the European community, to support the acquisition of social skills e.g. cognitive skills, communication skills and interaction skills for children with ASD. Moreover, it aims to develop a Dual Educational programme for parents and educators to be trained on digital skills necessary to implement digital and remote learning programmes for children with ASD.	VR Web 2.0
Virtual Reality for Augmenting Creativity and Effectiveness of School Training 2020-1-UK01-KA201-079177	VRACE project aims to assist teachers in learning how to efficiently utilize innovative digital, ICT technologies like virtual reality and Web 2.0 tools and social technologies in their school courses in order to assist students' learning and their knowledge construction and cooperation.	VR
DIGITAL UPSKILLING, INCLUSION AND ACCESS OF DISABLED PEOPLE IN THE LABOUR MARKET THROUGH 3D-TECHNOLOGIES IN VET' 2022-2-SI01-KA210-VET-000095861	The ALL43D project aims to equip educators/VET trainers or any other professionals working with young people with disabilities to upgrade their professional profiles concerning the introduction of emerging technologies in education, especially 3D Modeling, Design and Printing linked to social entrepreneurial skills for sustainable development and green transition.	3D Modelling, Design and Printing
Developing transversal digital competences for digital Continuous Vocational Education and Training in construction 2021-1-DE02-KA220-VET-000025109	The Digi-CVET focus on emerging technologies in VET is coping with DEAP 2. priority "...to include AI (also AR) and data related skills and support development of AI/AR leaning resources for [...] VET organisations..." and it particularly calls upon "...target advanced digital skills development through steps such as extending the digital opportunity trainingship to VET learners and offer professional development opportunities for teachers, trainers and other VET-staff"	AI AR Building Information Modelling
Transporte inteligente y sostenible (IoT&H2) en la Formación Profesional 2021-1-ES01-KA220-VET-000033013	… a project where students include all the emerging technologies that are beginning to be available to everyone, such as robotics through boards such as Arduino with its sensors and actuators, the 3D design and printing that can already be purchased for a small price and design with open platforms such as FreeCAD and graphic programming, such as an inventor app, which opens up a world of unimaginable possibilities without having knowledge of computer syntax.	Robotics 3D design and printing Graphic programming
Engaging Languages in Intercultural Virtual Exchange 2021-1-NL01-KA220-SCH-000032600	New experiences will be piloted making use of cutting-edge technology (Virtual & Augmented Reality and/or Artificial Intelligence) to promote engagement in virtual exchange activities. Research will be conducted on the usability of such emerging technologies for language education.	VR AR AI
Enlivened Laboratories within STEM Education – Motivating EU students to choosing STEM studies & careers and improving their performance in courses related to STEM education 2017-1-CY01-KA201-026775	Inspired by emerging technologies of IoT (Internet of Things) and AR (Augmented Reality), we managed to connect the physical and/or the remote laboratory to the digital world and turn it into an "Enlivened Laboratory".	IoT AR