Learning
Technology
Accelerator

LEARNING TECHNOLOGY ACCELERATOR LEA

D 4.3 Report on future global market of LEARNTECH 2030

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1. INTRODUCTION

The Deliverable 4.3 – Report of Future Global Market of LEARNTECH 2030 is a part of work package 4 – Industrial Dialogue Accelerator. The work package leader is University of Jyväskylä. The aim of the report is to present predictions and innovative trends of the future LEARNTECH market. The deliverable discusses current trending technologies, alongside with prominent new technologies such as wearable technology, blockchain and makerspaces, going further to make predictions of the future of learning. Different examples are chosen and predictions of the future are made with regard to their likely impact on learning and instruction in current and future educational designs.

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2. KEY DEFINITIONS

2.1 Learning Technology

Learning Technology can be defined as the communication and information related technologies used to support learning, teaching and assessment (Association for Learning Technology, 2018). In this sense, learning technologies can be both software and hardware. Trends of learning technology have evolved during the last two decades. First, the trend of learning object repositories shifted to Massive Open Online Courses (Gasevik et al., 2014). Later, attention was gained by learning management systems, followed by personalised learning environments. Thus, it can be stated that learning technology tends to follow the trends in information technology, accompanied by changing demands of education.

2.2 Future Learning Technology

Even though it is difficult to forecast the future, technology keeps developing towards one way or another. This is foremost lead by possibilities detected by organisations, as creating in-demand technological solutions requires effective and functional productisation. In this sense, educational technology may not greatly differ from other kinds of technology, since there is a need to create viable and scalable products.

In this light, it is no surprise that organisations tend to visualise the future of learning technology. After all, the success of highly specialised companies relies on their ability to make educators see the future of the technology that they are offering. By concentrating on views presented by different organisations, researchers and other relevant parties, there is a possibility to distinguish certain trends. However, these are restricted by the technical capabilities of modern technology, as well as by boundary conditions set

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by the educational context. It could be argued that defining the future of learning technology requires placing close attention towards three core elements: 1) technical capabilities and restrictions set by technology itself, including ease of use; 2) pedagogical meaningfulness of content, methods and tasks possible to implement with that technology and 3) special characteristics of the intended target group (end-users). Considering all of these elements facilitates the process of creating predictions, as it is not reasonable to distinguish learning technologies from their context (learning and teaching). Additionally, concentrating on aspects of pedagogy and target groups has the potential to increase accuracy of predictions, since functional technology is not designed merely for the sake of developing technology. Thus, in an optimal situation, future learning technology can be defined as a group of technological solutions, deriving from educational needs, created using purposeful technology and implemented to match the needs of the intended target group.

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3. TOWARDS FUTURE OF LEARNING

It has been widely acknowledged that the skills that students learn at school and the skills that they need in working life might not meet. Because of this, there is a need to change the ways of learning to better prepare students for future working life. New technological transformations have the ability to deepen, enrich and adaptively guide learning and interaction, which can e.g. increase motivation and hence ensure better learning results in general.

Prior research has suggested that students need support (scaffolding) to engage with and progress in active and effective (collaborative) learning. Contemporary and future technologies can be used to create tailored learning paths for individuals and groups, where content, methods and tasks fit each learner in a deeply personalised way. However, the ever expanding variety of different learning tools might feel overwhelming, especially as it is difficult to predict which technologies will be available in the (near) future. Additionally, the needs of schools differ, creating variation to the criteria used for selecting learning technology. Thus, it might be necessary to establish what can be expected from future learning technology, at both technical and functional level.

IMAILE project concentrated on pre-commercial procurement in education and technology-enhanced learning in Europe. In a needs analysis conducted in 2017, schools participating in the project defined personalised learning as their main need. Following this, it was discovered that personal learning environment suppliers focused especially on the development of learning analytics, artificial intelligence (AI), intelligent tutoring systems and gamification.

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However, it should be noted that technology-enhanced learning is a broad subject, and the future of learning and technological tools might differ from what schools and suppliers of today can imagine. Thus, by concentrating on the views of different parties working with technology-enhanced learning and especially their views of the future, there is a chance to gain insight of what the possible future might actually be.

4. METHODOLOGY

4.1 Predicting the Future

Even though future events are complexly shaped by various factors that are, in many cases, beyond human predictions, it would be difficult to plan future actions without considering the nature of possible futures. However, to be useful, predictions need to be based on credible evaluations. Thus, it might be beneficial to see whether same factors believed to shape the future events arise in different contexts. If this is true, there is a chance that organisations affected by these changes are already preparing for this probable future.

In many cases, however, vision of the future might not be straightforward. Instead, there might be many different futures endorsed by organisations, depending on their interests. Even though it might be hard for a single organisation to decide the course for e.g. information technology development, organisations tend to react to the actions taken by others. This can sometimes mean that a vision of one organisation becomes reality to the entire field. However, especially in the case of IT development, it is more beneficial to the organisations to concentrate on a variety of technologies, to be able to quickly react on trends once they start to emerge. Thus, the future of information technology development can be seen as a collection of many futures, depending on which technologies

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are seen as the most prominent ones for achieving organisational goals. Because of this, there might be noteable gain to be achieved if the promising, but still implicit signs are acted upon at the right time.

4.2 Weak Signals

It has been argued that organisations tend to fail to notice possibly fruitful opportunities due to their lack of knowledge of potential relationships between factors, causing changes in situations (Ansoff, 1975). In his pioneering research, Ansoff (1975) calls these sudden and unfamiliar events *strategic surprises*. He argues that strategic surprises can be handled with in two ways: 1) by having a functional crisis plan to execute when they occur and/or 2) by having timely and accurate information to forecast the effects on the organisation through strategic planning. Proper achievement of the latter can be eased by being responsive to weak signals, which can be defined as cues of emerging issues that can e.g. hint about future events or conditions (Hiltunen, 2010).

While high sensitivity to weak signals can be seen as a way to expose the organisation to higher risks, there is also a chance that early adoption of the right actions can provide great benefits (Coffman, 1997). In his theory on growth of weak signal in a noisy channel, Coffman (1997) proposes that the zone of highest opportunity accompanied by greatest risks occurs as a function of signal strength and time in a zone where signals may still be inseparable from other noise to a greater audience. Once this point has been passed, the signals can be viewed as strong as they reach the point of mainstream awareness. Consequently, the returns of the actions taken by the organisation start to diminish (Coffman, 1997). Thus, weak signals can be viewed as valuable assets in predicting future events and preparing to them in order to gain organisational benefit.

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4.3 Weak Signals in Predicting the Future of Learning Technology

To build a realistic and diverse understanding of the possible futures of learning technology, the organizations working in the field were closely studied. First, attention was placed towards public statements made by learning technology organisations. This stage included creating a list of different organisations working with learning technology and conducting Internet searches to establish whether or not the companies had made publicly available statements regarding the topic. When this was true, the statements were analysed to identify themes or technologies frequently brought up by the different organisations. The statements themselves were most often in the form of short blog type articles or videos in an online service. This stage ensured the identification of different signs relating to the prominent future of learning technology.

To gain an insight of the more implicit factors shaping the future, Internet searches were conducted to see whether parties outside the more well-known organisations had made statements of their own. In this stage, as well, the data mainly consisted of short articles and online videos. Since the information gathered from the first and second stages was still freely available for any Internet user, there was a need to supplement the data with more implicit information. For this purpose, learning technology events were visited, creating a data set including both presentations on specific subtopics given by organisation representatives as well as conversations with event attendees. By jointly analysing the data gathered from the three stages, the future trends in the global market of learning technology could be identified.

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5. FUTURE TRENDS IN THE GLOBAL MARKET OF LEARNING TECHNOLOGY

5.1 Artificial Intelligence

The rapid development of artificial intelligence (AI) algorithms and therewith personalised learning environments (PLEs) has the ability to deepen, enrich and adaptively learning and interaction. Personalised learning provides alter learning content to meet learner's level of knowledge and personal preferences of learning. PLEs are adaptive in a way that they adjust to learner and they can offer sources, materials and assessment to support individual learning (Pardo et al., 2019).

AI is utilised mainly in two ways in personalised learning environments. It can help in assessment of the learning process and give timely feedback of student's learning performance to both students themselves and their teachers through different dashboards. Another way to utilise AI in PLEs is in the form of personal learning assistants such as conversational agents able to communicate either with spoken or written language.

Automated assessment can save teacher's time by providing instant feedback and scaffolding (support) to students, independent of teacher's guidance and performing routine assessment tasks. On the other hand, teaching and tailored learning materials can be conveyed by conversational agents acting as pedagogical agents or virtual tutors. Agents are developed to have dialogues with learners and to support learning with questions, suggestions for additional material and encouraging comments.

For a long time, teaching has been provided from one teacher to students. The way to learn is transforming on the other hand towards one-to-one and

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at the same time collaborative learning. Due to societal change, development of working life and digitalisation, demands for the younger generations are very much different than they use to be. Digitalisation offers an access to knowledge, though it is useless one owns ability to use digital devices, digital content and digital literacy skills. Artificial intelligence can help children to learn 21st century skills and be their companion through their lifelong learning. (Luckin et. Al. 2016.)

It is forecast that in the near future, AI will have seven different roles in education (Lynch, 2018).

1. Automate grading – already existing AI technology is able to autonomously grade multiple choice of materials. However, through AI development, there is potential to go beyond standardised assessment.
2. Supporting teachers – some routine tasks and communication with students can be managed by AI. Chatbots have been used successfully in teacher-student communication.
3. Supporting students – It has been already suggested that in the future, students will have an AI lifelong companion starting from this generation. AI companion is aware of individuals strengths and weaknesses, since it is familiar with personal and school history of a student.
4. Meeting a variety of student needs – AI is also able to help students with their very specific needs by adapting materials to meet them. For example, studies have shown promising results in teaching social skills in the case of autism spectrum disorders.
5. Allowing teachers to act as learning motivators – AI will change teacher's role in classroom into a facilitator or a learning motivator.

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6. Providing personalised scaffolding – AI provides personalised tutoring which scaffolds students learning and interaction resulting to learning success.
7. Identifying weaknesses in the classroom – AI is able to recognise students who are underperforming in the learning tasks, which can be used to trigger teacher for further actions or to provide additional scaffolding for underperforming students.

5.2 Learning Analytics

Learning analytics is a trending field due to the increased need for customised and individually delivered teaching and learning content. It is tightly related to adaptive learning, which can be differentiated, personalised or individualised (Alexander et al., 2019). Individualised learning paths aim to meet the needs of each student and taylor learning content and style. Traditionally, teachers have been expected to adjust their teaching to meet the needs of the students accordingly. However, learning analytics can support learners in their individualised learning. Adaptive learning is expected to increase motivation to learn and enable individualised learning paths.

The expanding role of technology in the field of education can provide solutions to this problem. Learning analytics can provide personalised and timely correct feedback to each student. Students leave digital traces while they are using different learning technologies which can be captured and analysed and therefore develop recommendations to facilitate learning. According to a study, using learning analytics to provide feedback had a positive impact on the quality of feedback and academic achievement according to student perception (Pardo et. al., 2019.)

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In other words, learning analytics has to do with parties closely associated with teaching and learning, e.g. learners themselves, teachers, course designers and course evaluators. Learning analytics is seen "-- as a means to provide stakeholders (learners, educators, administrators, and funders) with better information and deep insight into the factors within the learning process that contribute to learner success. Analytics serve to guide decision making about educational reform and learner-level intervention for at-risk students." (Simons et al. 2011: 5)

5.3 Extended reality XR - Augmented, Virtual and Mixed Reality

In literature, virtual realities are traditionally described as technological systems accompanied by gear such as head-mounted displays to enable immersive experiences (see e.g. Steuer, 1992). Augmented reality, in turn, can be used to describe systems attempting to combine virtual elements with real-life settings (Azuma et al., 2001). It could be stated that while at its best, virtual reality is something that the user is cast into, augmented realities brings certain aspects of the virtual world to be a part of the user's everyday environment.

In this sense, augmented reality can be seen as a part of mixed reality (or extended reality), which as a term can be used to describe environments that fall somewhere between real and virtual environments (Milgram & Kishino, 1994). However, many different explanations for relationships between the definitions have been presented. Going beyond this, it is important to keep in mind that, ultimately, the environments are not so much defined by the technology or gear used, but by the degree to which a user can interact with the elements crucial to the intended experience or interaction provided by the environment itself.

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Already in 1992, instead of focusing on the technical executions of technologies, Steuer attempted to visualise the relationships between established, new and speculative technologies by placing them to a interactivity-vividness continuum. In this classification, a traditional book can be viewed as a technology that is quite low in both spectrums, while e.g. Holodeck proposed in the popular TV-show StarTrek can be placed quite high in both. An example of a technology with high vividness but low interactivity includes 3-D films and an online chat can be an experience that is interactive but not so much vivid (Steuer, 1992). Despite people's experiences being subjective, the classification visualises the desirable qualities and aspirations for future technology. Needless to say, new technologies using virtual and mixed reality are aiming to provide users experiences with high interaction combined with high vividness. However, the relationship between the two depends on the context in which the technology is to be used.

Perhaps the biggest motivation to use technology enhanced experiences of virtuality and vividness in education is its effects on motivation and immersion. Additionally, these qualities are often associated with games, among which children and adults alike enjoy spending time. However, one of the challenges of using immersive technology in education is its meaningful use. Even though technology would be developed enough to create immersive experiences, there should be a way of establishing whether or not the use of it actually enhances learning.

It is clear that some of the learning subjects such as chemistry and physics, but also geography and other topics as well could benefit a lot of these technology affordances. However, it is more problematic to see the benefits in the field of soft skills, because current XR tools are insufficient in terms of collaborative learning, problem solving and other 21st century skills.

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Nevertheless, there is no denying that virtual, augmented and mixed realities of today are highly immersive and have a lot of educational potential.

In the close future, technological development will bring real and virtual environments closer to one another. In this sense, XR technologies might become normative parts of people's everyday lives, making it possible to integrate educational activities into environments which are natural and meaningful for learners. As interest towards using tactile elements alongside with technology to learn is on the rise, there might be great potential in using low-threshold technologies, such as students' own mobile phones alongside with tactile elements to create motivational AR learning experiences. Another future perspective of XR technologies includes the dimensions of artificial touch and smell, which could be used in many educational fields, including special education.

In order to use XR technologies (virtual reality, augmented reality and mixed reality) in education, they need to be pedagogically and technologically meaningful. Both content and devices are now developing rapidly, but current consumer level tools are not ready for widespread educational use. Mainstream use of XR can become reality once devices used to consume content are as pervasive and ubiquitous as smartphones are today. In order to solve this challenge, many companies are developing their XR headsets, perhaps the most well known example in this category being Microsoft HoloLens.

5.4 Games and Gamification

The use of digital games for learning started to gain research attention at the turn of the century, making it a fairly new phenomenon in the field of education (Squire, 2005; Lee, Luchini, Michael, Morris & Soloway, 2004).

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However, simulations and games have been discussed in this context since the 1960s (Ruben, 1999). Even before digital games, e.g. board and card games have been successfully used to enhance learning, and continue to be used alongside with newer technology. In this sense, using games to learn itself is not a new phenomenon. However, games have long been viewed as something to be used in more of an informal learning, while gamification-enhanced formal learning is only recently starting to gain more and more attention. Going further, the question seems to be whether or not and to which extend learning can be gamified without students losing internal motivation to learn. However, gamification can be considered both as a pedagogical method, but also in the form of technological tools. Today both approaches are present in the educational contexts, but mainly used by teachers who are early adopters.

First, it should be noted that people have different reasons to play games, be them in digital or another form. Reasons to play games can include enjoyment, but also feelings of success, competence or achievement. Social aspects of gaming, especially in the case of young people, should not be forgotten. However, it has been noticed that certain elements used in popular games seem to appeal to several people. These include e.g. the use of leader boards and collecting badges based on achievements (see e.g. Hamari, 2017). Once these elements are observed in the educational context, it could be questioned whether they support students' internal motivation to learn, as they might highlight the outcome instead of the learning process itself. Thus, in education, gamification should be executed with care and with consideration to the specific context and the age-group in question. Today, it is possible to use open spaces in education, which is an example of gamification in the form of educational technology. Games itself are quite normal educational tools, drill-and-practise games are quite typical in many levels of the education, but also open-ended games are used in schools, such as Minecraft Education Edition.

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It is possible that in the future gamification is used as a natural part of learning, since playing digital games is an essential part of the contemporary life of younger generations. However, there are still struggles in how to incorporate gamification into education in a meaningful manner. Because of this, future ventures to gamify learning should concentrate on designing gamified learning environments, as contrasted with trying to incorporate gamification into existing environments. In this sense, games and gamification should be in the center of the design process itself. Additionally, it should be noted that not all gamified environments have to be highly immersive. Instead, it could better serve the purposes of learning to have environments with different levels of immersion, as this has the chance to ensure variation in learning stimuli. In sum, there is a need to make games and gamification a meaningful part of education, shifting the focus from single technological solutions to gamification plans and pedagogical functionality.

5.5 Pedagogical Agents

Educational specialists have forecasted that teachers will be assisted by machine agents such as social robots and virtual tutors within the next 10 years. Some educational experts even predict that educational robots and agents take the role of the teachers (Bodkin, 2017). Even though this may never happen, it is likely that AI will shape the future of educational field and how teachers teach and students learn. In the ever complexifying world, personalised learning and individual learning paths can be a means to prepare people to cope in the changing working life. Today's children and youth need to build competences to be able to work in occupations of the future.

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Personalised learning environments should utilise technological advances. One of the key innovation in the short term future is communicative AI including conversational agents, pedagogical agents and social robots (Huang et al., 2019). Communication is no more occuring merely *through* technology but *with* technology and communicative AI such as pedagogical agent can turn learning experiences into personalised one-to-one learning. Research has been carried out to study pedagogical agents in order to understand how instructional communication should be designed to enhance learning. Communication is a *meaning-making process* among humans and machines instead of plain interaction. (Guzman, 2018.) Technology can give rise to convenience for both students and teachers due to its ability to be used to widen perceptions of how teaching is conducted and providing new, exciting ways to teach and learn. Additionally, technology can save teacher's time and be cost effective at the same time. (Edwards et al., 2016.)

Pedagogical agents (PA) are characters which are intended to facilitate learning (Lin et Al., 2013). PAs appear in digital learning environments to help students and can be have physical appearance such as a robot. The main feature is their ability to communicate with students as they are communicational agents utilising artificial intelligence. Their strength is that they can take multiple roles depending of the needs of a student. These roles can be for example peer, competitor, teacher or learning assistant. Perhaps one of the most known robot used in teaching is Pepper. Pepper is a social humanoid robot, claimed to perfectly meet instructional goals in education, providing new ways for pedagogy and classwork (Softbank Robotics).

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5.6 Robotics

In recent years, robotics has been a popular topic especially in the field of STEAM (science, technology, engineering, arts, mathematics) education. Use of robotics to design and model situations and elements with different levels of complexity has been perceived as a potential channel to enhance students' creativity and autonomous work (e.g. Arís & Orcos, 2019) – both of which are necessary skills for future employment. Thus, in its current form, robotics is above all used to support learning of students in domains where intrinsic (internal) motivation of students has been traditionally hard to reach.

Jung and Won (2018), who studied research trends in robotics education for young children, conclude that attention should be placed towards not only technology, but also pedagogy and children themselves. Additionally, the researchers stress the importance of focusing on the learning process instead of focusing on the outcome. Even though robotics is often viewed as a part of STEAM education, it should receive more attention as an individual branch to be meaningfully implemented in schools.

Once robotics is viewed as a larger entity, different sub-branches start to emerge. Possible problems with robotics include environmental friendliness and ethical questions of what possible future robots with highly developed AI can be used for. In discussions, it is rarely believed that robotics could be used to replace teachers in education in the future, as replacing natural teacher-student interaction would require technology that is not likely to be reachable in the coming years. Additionally, there is the question of whether or not teachers should be replaced with robotics, were it possible to do so. That is, what would be the value gained from this process. Above all, building meaningful relationships is one development goal that is highly enforced by school environment, and it might be detrimental to child

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development to decrease the amount of human contact in schools. However, robotics could be used to enhance teaching in situations where generally less interaction exists between teacher and students, which is the case in some forms of distance education (e.g. MOOCs).

All in all, as the interest towards combining latest technology with tactile learning aids increases, it is likely that robotics continues to gain popularity in the field of STEAM education. Even though it might not be probable or meaningful to use robotics in education to replace teachers, in some scenarios use of robotics might bring education closer to students, making it more personal and tactile. However, this calls for more specialised branches of research to capture the essence of different entities and understand different types and levels of robotics use in teaching and learning.

5.7 Other Prominent Technologies

Blockchain – While blockchain is viewed as a trending technology, it has not been widely implemented in the field of learning technology. However, as learning communities are expanding in terms of volume and diversity, blockchain could offer solutions for ensuring the security of exchanging learning information between ecosystems, institutions and other stakeholders. Nevertheless, there might be a need to place attention towards certain security and ethics related dimensions before it can be deemed to be a prominent technology to be used used for learning in K-12 setting.

Wearable Technologies – Perhaps the greatest advance of wearable technology can be seen in its possibilities for health tracking. Especially accessories such as watches and rings have been designed with this goal in mind, making technology use itself as discreet as possible. Wearable

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technologies have been used to track the health of students, but a myriad of potential use cases is still left to be identified.

For example, years of research in the field of psychophysiology has confirmed that our cognition is not separate from the body (Critchley, Eccles, & Garfinkel, 2013), instead many mental states are reflected through physiological signals (Pecchinenda & Smith, 1996). It is quite clear that wearables in the future could become functional gadgets in the learning ecosystem, because these can provide information of the learning processes. However, in the case that wearable technologies are used to gather user information, there is a need to evaluate how to reach a sufficient level of student information privacy.

Makerspaces and Maker education – Making is a central concept in the maker education approach. In practice, making is "a class of activities focused on designing, building, modifying, and/or repurposing material objects, for playing or useful ends, oriented toward making a 'product' that can be used, interact with, or demonstrated" (Martin, 2015, p. 31)

The basic idea of maker culture and digital fabrication places the learner firmly at the center of the learning process, while connecting learning to real-world issues and meaningful problems. In the context of digital fabrication and fabrication laboratories (fab labs), complex, undefined, open-ended, and unstructured problem-solving activities are typical (Chan & Blikstein, 2018). Taylor (2016) has concluded that the activities in "makerspaces" can be transformed into classroom projects that match the goals of 21st century education. In other words, the overall learning experience through making can be empowering and can nurture students' creativity and inventiveness among other 21st century skills (Blikstein, 2013).

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Makerspace is a concept which combines many aspects, including the idea that students are makers as well as design thinking and media literacy. Makerspace is designed to encourage students to learn collaboratively while doing something concrete with their hands. Even though Makerspace can include all kinds of traditional materials and equipment, learning technologies play usually an important role.

21st Century Learning Environments – Discussing future learning environments in general requires placing attention towards their elements. These can be quite different between classes and schools, as student groups have differing needs. Even though there are currently not many parties that have gone through the process of making physical school environment correspond to the needs of digital learning, in the future more attention could be paid on the interaction between physical and digital environments. While it is important to bring meaningful technologies into schools, it should be noted that better outcomes could be achieved when physical and social environments are designed to work in collaboration with new technologies.

6. CONCLUSIONS

6.1 Learning Technology 2030

It can be concluded that when visualising future learning technology, the emphasis should not fixate on the technical properties of certain technological solutions. Instead, it should be kept in mind that many of the introduced technologies can be used in educational settings, as long as attention is placed towards pedagogical meaningfulness as well as special characteristics of children as end users.

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However, in regards to recent developments, it seems likely that learning technologies using different levels of AI, as well as technologies mixing realities, will gain more attention in the coming years. This is due to the fact that AI has potential in producing accurate data of learning processes, making adaptive learning an outcome that could personalise learning experiences, helping students learn at their own pace and level. Augmented reality, in turn, is already succesfully used in learning, creating interest towards combining interaction with tactile and virtual elements in an engaging way. However, this is dependant of how these technologies evolve and whether they will succeed to become parts of children and young people's everyday lifes.

At the same time, it is evident that the fundamentals of learning are changing rapidly. This is due to changes in modern and future working life, creating a new demand for the employees to possess more wide and different skill sets than before. For example, physical labor and routine information work related professions will continue to be replaced with new technology. This calls for skills in critical and creative thinking, rapidly increasing the proportion of positions relating to this segment in working life. Because of this, children should be prepared from early on to building and developing these skills throughout their life.

Even though future technology can be viewed as a threat to certain professions, it can be used to support the changing demands. For example, risen interest towards AI has the potential to create more timely and precise information, decreasing the possibility for human error. Additionally, while mechanical and even more sophisticated and time-consuming tasks can be outsourced to AI, human resources can be better allocated to higher tasks such as controlling the process, decision-making and innovation of new processes and technologies. In the case of learning

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technology, these properties can be used to enhance learning experience and provide children with optimal skill sets for the future. Thus, future learning technology creates a chance to achieve human potential at its fullest.

Forecasts predict that around half of the existing jobs will disappear and generation of children and youth will be working in the jobs that have not yet been created. The question is, how to prepare them to meet the challenges of an unknown future working life demands. Fortunately, today's education is no more centered around one-way information dissemination, but teaching students to agilely and collaboratively create new knowledge to solve complex problems. In the future, people are increasingly expected to make sense of a multifaceted reality, creating a need for posessing wider skill sets. Transversal skills include basic skills such as communication, team-working, problem solving and learning. For example, the skill set provided by formal education aiming for profession has its pitfalls in being quite narrow, leaving a person vulnerable in ever changing labour market where flexibility and lifelong learning are highly in demand.

6.2 Challenges for Future Learning Technology

One of the biggest challenges for learning technology is how to make organisations realise the benefits of learning. While a lot of resources are allocated to technologies and processes, organisations often fail to invest in education of employees. These attitudes can have detrimental effects on the development of K-12 learning technologies as well, as the development of these technologies is often carried out by private organisations. Additionally, it is not enough that children train transversal skills in school, as these skills as well as other skills relevant for personal growth and working life should be developed throughout their life in the form of lifelong learning.

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Unfortunately, good intentions are usually not enough to disseminate new practices and processes. However, with multidisciplinary and cross-sectional cooperation, there is a chance for tremendous changes to be achieved. For example, economical models could be built to show the financial benefits of learning for organisations. Additionally, the use of enabling resources could be enhanced by legislative, national or EU wide alignments. If there is no readiness to invest in these technologies, it is noticeably more difficult to achieve development and keep up with the demands of future working life.

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