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Editorial: A Look at the Digitalisation of Education in the Context of Ethical, Legal, and Social Implications

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ABSTRACT: In this article digital transformation in education and the associated ethical, legal, and social implications (ELSI) are considered. In order to make use of the innovation potential of mixed reality and artificial intelligence in vocational education and training, it is argued in this article that a constructive approach should be used for the ethical, legal, and social implications. To this end, after the introduction and a brief presentation of the potential of digital technologies, selected ethical, legal, and social implications are discussed in order to provide starting points and recommendations for a reflective approach to the ELSI aspects.

Keywords: Digital transformation, Mixed Reality (MR), Artificial Intelligence (AI), Learning Analytics (LA), Human-Technology Interaction (HTI), ELSI

Editorial: Ein Blick auf die Digitalisierung der Bildung im Kontext ethischer, rechtlicher und sozialer Implikationen

ZUSAMMENFASSUNG: Der vorliegende Beitrag beschäftigt sich mit der digitalen Transformation und wirft hierbei einen Blick auf die ethischen, rechtlichen und sozialen Implikationen (ELSI) die sich mit dem Einsatz digitaler Technologien in der Bildung verbinden. Um die Innovationspotenziale von Mixed-Reality und Künstlicher Intelligenz in der beruflichen Aus- und Weiterbildung nutzbar zu machen, wird im Beitrag für einen konstruktiven Umgang mit den ethischen, rechtlichen und sozialen Implikationen plädiert. Hierzu werden nach der Einleitung und einer kurzen Darstellung der Potenziale digitaler Technologien ausgewählte ethische, rechtliche und soziale Implikationen diskutiert, um dann Ansatzpunkte und Empfehlungen für einen reflektierten Umgang mit den ELSI-Aspekten darzustellen.

Schlüsselwörter: Digitale Transformation, Mixed Reality (MR), Künstliche Intelligenz (KI), Learning Analytics (LA), Mensch-Technik-Interaktion (MTI), ELSI

1 Introduction

A current digital transformation is changing the way we live in many areas of society. New digital technologies are making their way into private and professional areas as well as into school and university education. These are intended to optimise teaching and learning. In its strategy paper "Education in the Digital World", the Standing Conference of the Ministers of Education and Cultural Affairs of the States in the Federal Republic of Germany (KMK 2016) has suggested a new cultural technique that should take place alongside traditional cultural methods and calls on teachers to be more capable than before in using digital media in a profession-oriented manner. Even if the actual use of technology-based worlds of experience in teaching, artificial intelligence (AI) or the Internet of Things (IoT) is still in its infancy in many places, the new smart learning environments are expected to deliver all kinds of potential for the educational process (Van Leeuwen & Rummel 2019; Kärner et al. 2021; Zinn 2020; Seufert et al. 2021). The Enquete Commission on Vocational Education and Training sees digitalisation, also in connection with related surge due to the COVID-19 pandemic, as a pioneering option for dealing better with socio-cultural problems in vocational education and training in the medium and long term (cf. e.g. Enquete Kommission berufliche Bildung 2021, p. 35).

In the current second wave of digitalisation, it is no longer just a matter of digitally recording and processing diverse information, as was the case during the first wave of digitalisation (Wahlster 2017). Instead, the current wave of digital transformation is related to the use of intelligent systems and machines that understand learning and can act autonomously. The areas of application for both AI-supported systems and technology-based worlds of experience are broad. Moreover, one aim of their introduction is to induce various positive developments in the field of education. In addition to the potential of digitalisation, risks are seen at the same time in the use of digital technologies in education and in the individual context of human-technology interaction (HTI). The digital transformation in the education sector is associated with various opportunities, but at the same time also with fundamental challenges and potential fields of development. Van Ackeren et al. state:

> "Social change in a digitalised, networked, and automated world and the transformation processes associated with digitalisation go hand in hand with questions about systematic needs and potentials for change, which, in addition to other areas such as economics and law, are also and especially important to ask and clarify in the education sector. This concerns equally a technological, a socio-cultural, and an application-related perspective". (van Ackeren et al. 2019, p. 105)

This paper is focused on the ethical, legal, and social implications (ELSI or ELSA, here "A" stands for aspects) associated with the digitalisation and increasing mediatisation of teaching. In the area of the promotion of digitalisation for higher education, the initial topic of this ELSI study currently is of central importance in national and international research projects. Among others, this occurs in the research programme Human-Technology Interaction (HTI) of the Federal Ministry of Education and Research in Germany (BMBF 2020) or in the programme "Strengthening higher education teaching through digitalisation - innovatively rethinking, testing, and structurally anchoring classroom teaching, blended learning and online teaching" of the Foundation for Innovation in Higher Education (Stiftung Innovation in der Hochschullehre 2020).

The focus of this article is on the use of mixed reality (MR) and artificial intelligence (AI), including the use of learning analytics (LA). Within the scope of the article and in the context of the broad ethical, legal, and social implications, it will not be possible to provide a detailed treatment of the initial topic. Moreover, this was also not the aim of the article. Rather, the article is intended to encourage the reader to reflect on the initial topic and to help constructively shape ethically, legally, and socially sensitive teaching in the context of the innovative potential use of new digital technologies.

The article is comprised of five sections, including the introduction. The second section gives a brief introduction to the fundamental potential of digitalisation in education. Building on this, in the third section selected ethical, legal, and social aspects in the field of reference are discussed. In the fourth section, an outline is made of the starting points for a constructive approach to ELSI aspects of the digitalisation of education. A concluding summary is given in the fifth section.

2. Potential

Open educational resources (OER), massive open online courses (MOOCS), e-assessment, learning analytics (LA), blended learning, game-based learning (GBL), serious games, apps, web video, social media, virtual reality (VR), augmented reality (AR), mixed reality (MR), and artificial intelligence (AI) are individually associated with a wide range of potential and innovations for the education sector in general, and for teaching and learning in VET in particular (cf. e.g. Autorengruppe des Ausschusses für Bildung, Forschung und Technikfolgenabschätzung 2016). This raises the question of what could actually constitute an innovation in the field of education, as well as how to integrate digital technologies in teaching.

The term "innovation" can be approximately described as a development that is connected with a technical, economic, and social change. In this context, not only does the mere inclusion of technical artefacts such as MR or AI represent an innovative moment, but also the varying use of the artefacts throughout a number of changed perspectives, ideas or convictions (Braun-Thürmann 2005; Rürup & Bormann 2013). The Foundation for Innovation in Higher Education states:

> "Innovations are understood as new developments within processes, practices, and structures that generate significant added value for the teaching and learning process in their specific context. These innovations are not an end in themselves - they serve to improve the quality of higher education institutions as educational institutions with their qualification goals of professional competence, critical abilities, and creativity. The funded innovations have an impact in their contexts and ideally beyond." (Stiftung Innovation in der Hochschullehre 2020)

However, what concrete innovation potential can be associated with the use of technology-based worlds of experience, the inclusion of artificial intelligence (AI), or the use of learning analytics (LA) systems in the education sector? This will be discussed in more detail below after the terms have been defined briefly.

Virtual reality (VR), augmented reality (AR), mixed reality (MR) and cross reality (XR) are referred to as technology-based worlds of experience. By using these various digital technologies, multiple possibilities for vocational teaching and learning can be established (cf. e.g. Dörner et al. 2014; Pletz & Zinn 2020a; Zinn 2020). Technologically, virtual reality applications are computer-generated real-time representations of real or fictitious environments into which people can virtually enter and interact via artificial (e.g. via a controller) and natural user interfaces (e.g. via a head-mounted display or data gloves). A typical feature is that users can experience being in an unfamiliar virtual place. Virtual environments can thus enable new learning and working experiences by using highly authentic virtual machines and systems. Virtual environments in VET can provide a protected training space for individuals with special needs requiring support and assistance (Zinn et al. 2020). They enable collaborative and cooperative learning and work across the VET school and company learning site (Prodromou 2020; Zinn 2020; Pletz & Zinn 2020b; Pletz 2021). By using technology-based experience, it is possible to influence psychophysical perception processes in a context-related manner. For example, in the area of special adaptive support services for people with particular visual, auditory, and tactile impairments (cf. e.g. Zinn 2021). The new forms of interaction via natural interfaces for visualisation, interaction, and movement enable users to have a more authentic learning and working experience through more direct control than achieved on traditional computers, and can thus promote cognitive, motivational, and affective learning processes (ibid.). Context-based VR environments can be used to explore things that are physically and technically inaccessible (e.g. structure of microscopic and macroscopic matter), to simulate dangerous work situations (e.g. in the context of occupational safety training) or to recreate and use expensive experiments virtually (e.g. interactive virtual chemistry and physics laboratory) (cf. e.g. Guo, Ditton & Zinn 2019). Studies on their effects show that users of VR applications can be "immersed" and react to the media on offer as if the (virtually) perceived thing were real, although it does not exist "in real life" (cf. e.g. Zinn, Guo & Sari 2016).

There is no universally accepted definition for artificial intelligence (AI). For example, according to Graf Ballestrem et al. (2020, p. 5), AI is described as follows: "Artificial intelligence (AI) refers to systems that exhibit intelligent behaviour by analysing their environment and - with some degree of autonomy - taking actions to achieve certain goals." However, according to Nilsson (2009), a technical system is considered artificially intelligent if it can implement analogous performance to human cognition. Alternatively, AI systems must be able to process symbols, unfold internal models, mentally simulate and, if necessary, implement action plans, estimate probabilities and deal with new situations, as well as make decisions more or less autonomously (cf. Rasmussen et al. 1994).

If one follows a socio-technical systems approach when considering the autonomy of AI systems (cf. e.g. Billings 1997), AI systems should be developed in such a way that these systems interact optimally with humans. According to Parasuraman, Sheridan and Wickens (2000), and the assumptions of a simplified human cognition model, an AI system can perform autonomously to varying degrees the four functions: information intake, information processing, decision making and action implementation. An AI system with the degree of automation (for the four functions low, high, high, low, respectively) is characterised, for example, by the fact that the technical system processes the information and suggests adaptive actions, but the human must absorb the information and take over the implementation of the action. Consequently, AI systems are considered to be so-called assistance systems as long as they use a lower degree of action automation than the human.

Studies on the impact of AI systems across tasks show that more and/or higher automation in the four functions does not per se contribute to any better interaction between human and artificial intelligence and, thus, task performance. Meta-analyses across different activities show heterogeneous performance findings (Wickens et al. 2010; Omnasch et al. 2014). In a systematic review of learning analytics, Ifenthaler and Yau found that learning analytics are used to analyse learning success primarily in order to detect risky situations and that few effective intervention strategies are available in the field of reference (Ifenthaler & Yau 2021).

For the education sector in general, and in particular for the vocational and higher education sector, all kinds of promising aspects are associated with AI systems (cf. e.g. Seufert et al. 2021). According to the High-Level Expert Group on Artificial Intelligence (short: AI-HLEG), which was set up by the European Commission,

> "AI can be a great tool for tackling inequalities in education and creating personalised and adaptable education programmes that can help all people acquire new qualifications, skills, and competences according to their ability to learn. From primary school to university, AI could increase both the speed and quality of learning." (Pekka et al. 2018, p. 43).

Applications of AI in education are seen, among other things, in the use of intelligent tutorial systems (ITS), assistance systems, expert systems or for the assistance of persons with socio-emotional support needs. The use of AI systems, or learning analytics (LA), can be found in different occupational fields. Fields of application are localised in the industrial-technical occupational field, commercial occupations, in IT or in care occupations (cf. e.g. Ertl & Seifried 2021). Innovative benefits of the use of learning analytics can be found in the improved knowledge about the decision-making process of the teacher with regard to learning behaviour, processes and strategies. With the help of the data-based insights, better curriculum design and learning support should be possible, among other things. LA systems are expected to provide both teachers and learners with timely feedback on the learning process and support learning success (cf. e.g. Jude et al. 2020; Kärner, Warwas & Schumann 2021; Lipp et al. 2021).

As a preliminary conclusion, it should be emphasised that the technologies at the centre of this article are associated with a wide range of "innovative" potential with regard to more digitally shaped teaching using VR, AR, AI, or LA. Even if the individual digital technologies and the new human-technology interaction solutions (HTI solutions) linked to them are still little used or currently in the conception phase in many places, fundamental improvement is seen with these new digital possibilities both in the school and university sector, as well as in the tertiary education sector. The limited use is among other things due to a lack of technical equipment in schools and universities as well as a lack of professionalisation opportunities for teachers, in addition to the fact that teaching can be regarded as complex.

3 Ethical, legal, and social challenges

Within the field of digital education, in which connectivity occurs via mobile devices, information exchanges happen in networked virtual and extended teaching and learning environments, extensive data is generated and analysed, and its development occurs in a data-based and virtual way, many ethical, legal, and social implications arise.

The ethical implications associated with digitalisation and increasing mediatisation are related to the moral values, norms, and principles of society. Moral aspects here include the autonomy of the individual, equality, and the dignity of the person, or in short, the theory and practice of good behaviour within our digital and increasingly virtual educational society.

The use of AI systems brings up different challenges with regard to moral questions. These can arise, for example, from a conflict between the respect for the autonomy of teachers or students with regard to their individual teaching and learning interests, personal objectives and attitudes, and the functions assumed by the AI systems in information reception, processing, decision-making, and action implementation. The question is: Which decisions may and should AI systems take over or not take over in the individual teaching and learning arrangement?

With the use of highly autonomous AI systems, there is a danger that the self-determination of teachers and students in the educational context is no longer guaranteed. The freedom of learners to self-determine the educational content in their individual context and to evaluate it with regard to its personal relevance can or should even be restricted by intelligent tutorial systems (ITS) and their algorithms. On the one hand, an orientation towards the individual prerequisites and needs of the individual student is pedagogically desirable in the context of individualisation. On the other hand, there is the danger that the self-determination of the students and the teaching autonomy of the teachers is substantially restricted by highly automated information acquisition, processing, decision-making, and action implementation in an AI-supported system.

There are complex algorithms underlying intelligent tutorial systems (ITS) in addition to the basic system-theoretical assumptions. If it is assumed that teachers cannot comprehend the data, parameters and calculation steps of a neural network recorded by an AI system, then they must regard the AI system as a "black box". Consequently, teachers would then have to trust the correct functionality of the AI system in the individual teaching-learning arrangement.

Critics of digitalisation in education warn of the consequences of using such systems and assume that the use of digital media can only promote the learning effects of pupils to a limited extent, if at all. Deliberately provocative questions have been raised in the discourse about this point. For example, how can learners still learn to learn if AI systems and educational platforms always select the "right" learning content for them? How can students still develop sophisticated beliefs about knowledge and the acquisition of knowledge if the decision to select learning content is taken away from them by the AI system? In their individual educational process, don't learners also have to make the personal experience of separating "important" educational content from "unimportant" content? How can students learn to deal with the plurality of information? Or will AI systems in the future take over information selection in general, as is already practiced in many places in the consumer sector with AI-supported display systems on the Internet? Will teachers in the future assign their grades on the basis of AI-supported data analysis - without having to subjectively assess the individual case in more detail? How will the individual relationship between a teacher and a student develop if, due to the virtual teaching and learning formats, the (real) personal contact times in the teaching and learning arrangements decrease? What happens if educational platforms are organised centrally and no longer support educational freedom? These, and other similar questions, are in part exaggerated, provocative and empirically unsubstantiated. Moreover, a dualistic discourse on digitalisation in education between good and bad, between black and white, should not be considered to be goal-oariented. Ethical challenges also exist with the use of AI-supported robots in care professions (cf. e.g. Bendel 2021). For example, the use of care robots poses fundamental challenges in connection with the human dignity and privacy of users or, for example, with regard to who has responsibility and liability in the event of personal injury. These and similar other challenges need to be addressed constructively and in an appropriate manner for the respective situation; it can be suggested, that simply rejecting the technology would not be of any benefit.

On the one hand, MR systems enable new innovative teaching and learning paths (see above), on the other hand, users of virtual and augmented learning environments can be consciously or unconsciously deceived about reality (Zinn 2019). Along with the mediatisation through technology-based experiences, new habits, norms, values, and expectations have emerged in the field of education. It can be assumed that experiences in the sensory "real" world of teachers and students may change, become limited and be open to manipulation with MR systems. Both virtual and augmented realities do not have to conform to the laws of nature and represent reality in "reality". However, these aspects need to be further explored and discussed with regard to their implications in a constructively critical way in the context of teacher education and beyond (ibid.).

With the greater use of flexible virtual technological tools in the context of the pandemic-related vocational school and company closures, fewer "real" social (educational) contacts between teachers and learners are possible. At the same time, in many places it is only through the use of these technologies that realisable, spatially flexible teaching and learning opportunities can be made possible (e.g. in the context of live online teaching). Hepp suggests that the use of digital media can be linked to a process of cultural change (cf. e.g. Hepp 2013). Consequently, the question arises as to how cultural educational processes change in an increasingly virtual and digital world of teaching and learning with regards to ethical ideas. The separation between virtual, augmented, and real environments can potentially lead to cognitive, motivational and affective challenges for teachers and students (Zinn 2019). Already in the context of video conferencing, which was implemented in many places due to the pandemic, the boundaries of autonomy of the private sphere changed, in that, among other things, voluntary or involuntary insights into the home and living environment of teachers and students became possible. However, for this problem there are technical solutions to limit the actual insight into the private sphere. They just have to be used.

With technical ease, personal data can also be stored and further used in the virtual scenarios without the knowledge and consent of the person. Thus, there are legal challenges associated with the use of this technology. It is consequently necessary to ask what are the legal implications of the digital transformation process, what legal influences will teaching be exposed to and under what conditions will digital technologies be used in schools and universities and to what extent. The General Data Protection Regulation (GDPR) is fundamentally relevant for the assessment of the legal situation in the education sector. The GDPR contains provisions on the protection of individuals with regard to the processing of personal data and on the free movement of such data. The GDPR aims to safeguard the fundamental rights and freedoms of natural persons and their right to have their personal data protected, and regulates the free flow of personal data in the European Union, which can neither be restricted nor prohibited for reasons of the protection of natural persons with regard to the processing of personal data (DSGVO 2017). However, with regard to this, the use of LA systems in particular seems to be problematic (cf. e.g. Graf Ballestrem et al. 2020). LA systems pose challenges in terms of data collection and the protection of teachers' and students' personal data. The questions that arise are: How is it ensured that pupils (or their guardians) can stop the collection, evaluation and storage of individually collected data at any time using their free self-determination, and without pedagogical consequences and peer pressure? What happens if the students restrict the personal data collection and evaluation procedures to such an extent that no meaningful analysis results can be generated (Salden et al. 2014)? What user data is recorded, what software is used and where are the collected data sets stored in a data protection compliant manner? What profiles are generated? Who has access to the user data and the profiles calculated by the algorithm? And who assumes legal responsibility for the collection, storage and processing of the data? Consequently, there are many questions that arise in the current situation with regard to the development and testing of LA systems in education.

Schools and universities, as well as individual teachers and learners have a duty to act in accordance with the law. Data protection aspects are not new in the education sector; moreover, it can also be assumed that the complexity of ensuring data protection in schools will increase with the implementation of new digital methods in teaching. In the context of learning analytics, problem areas and open questions regarding the control and ownership of personal data are particularly prevalent. The question arises as to whom the collected data belongs, is it to the learners, the educational institutions or the operators of the learning management systems and to what extent is there transparency for the learners regarding the methods of data collection and evaluation (Sclater 2014).

In its study on digitalisation in schools in the field of learning analytics, the Leibniz Institute for Educational Research and Information concludes that the use of data and data protection in the federal states is currently interpreted rather restrictively and proposes the creation of a common meta-standard for learning analytics reporting in the context of educational monitoring in Germany. According to the crux of the study, learning analytics is currently not extensively implemented in German schools, particularly due to the less than transparent regulations on the collection, storage, and use of data and its novelty. Whether learning analytics actually contributes to any improvements of teaching and learning arrangements, and to the development of learners' competences is, according to the authors, still a subject of educational research (Jude et al. 2020). For more in-depth information on the legal implications, please refer to the relevant literature (cf. e.g. Graf Ballestrem et al. Graf Ballestrem et al. 2020; a good overview is also provided by the 2016 issue of the Journal of Learning Analytics, Vol.3 No.1, entitled "Ethics and Privacy in Learning Analytics").

In the context of the social aspects, challenges arise regarding distributive justice, access to and availability of digital media (cf. ICLIS 2018; van Ackeren, Endberg & Locker-Grütjen 2020). Studies on access to digital media show a "digital gap" within our society. Children and young people from socially disadvantaged families often have limited access to digital devices and often have only rudimentary skills in using digital media (van Ackeren, Endberg & Locker-Grütjen 2020). Although the Bring Your Own Device (BYOD) approach has economic and ecological advantages for educational institutions, it can also make it more difficult to ensure educational equity. In the ICILS 2018 comparative school study, clear differences in the level of competence of eighth-graders due to their background were found. According to this study, young people from socioeconomically less privileged parental homes have lower computer- and information-related skills, as was already shown in the ICILS 2013 (Senkbeil et al. 2019). On the one hand, digitalisation is associated with the hope of more educational equality and individualised support for students, but on the other hand, the results of current studies on digitalisation in education during the COVID-19 pandemic indicate that the level of aspiration is lower in disadvantaged schools compared to privileged schools (Bremm 2021). Van Ackeren, Endberg and Locker-Grütjen (2020) therefore assume that the social education gap for children and young people will continue to widen.

4 Starting points for dealing with the ELSI aspects

In the last few years, recommendations, guidelines or principles for a constructive engagement with the ethical, legal, and social implications of digitalisation have been published for various areas of society, including higher education, the corporate and foundation sector, the European Union, as well as in the context of research and development projects (cf. e.g. Ferguson 2016; Drachsler & Greller 2016; Pekka et al. e.g. Ferguson 2016; Drachsler & Greller 2016; Pekka et al. 2018; Floridi et al. 2018; Gressel 2019; Hallensleben et al. 2020; Ifenthaler & Yau 2021). In the VET sector, the focus of these points has so far been primarily on conceptual aspects, research directions and implications of AI for various occupational fields (cf. e.g. Seufert et al. 2021; Ertl & Seifried 2021).

There are context- and technology-related contributions on the initial digitalisation topic as well as publications that consider the ethical, legal, and social implications of digitalisation independently of a specific technology and field of application. The following four exemplary contributions by Ferguson (2016), Pekka et al. (2018), Ifenthaler & Yau (2021) and Gressel (2019) represent a limited selection, but, with their individual objectives, ethical guidelines, recommendations for action and ethical principles, a constructive starting point for further discourse, and a situation- and context-related differentiation.

- Ferguson derives nine ethical objectives for dealing with ELSI in the context of learning analytics in education. Ferguson sees the priority of educational success, the trustworthiness of the educational institution, respect for private and group values, and respect for property rights as central ethical objectives. In addition, according to

Ferguson, teachers and educational institutions must be able to protect students, establish real educational justice, fair laws must be applied and observed equally, and freedom from threat and personal integrity must be guaranteed (Ferguson 2016, p. 11f.). With this list, even five year ago, Ferguson expressly called on the members of the learning analytics community to reflect on the relevant values and principles in the context of learning analytics and to actively support comprehensive ethical behaviour in research and teaching (ibid.).

- According to Pekka et al., trustworthy AI should firstly be legitimate and be used in accordance with applicable laws and regulations. Secondly, with its use ethical principles and values should be respected, and thirdly, it should be robust from a technical perspective and its use should take into account the social environment (Pekka et al. 2018). On the basis of these postulates, the European Commission's High Level Expert Group on Artificial Intelligence (HEG-KI) considered seven requirements for trustworthy AI to be significant in its ethical guidelines based on the EU Charter of Fundamental Rights. According to the authors, human action and human supervision have priority for AI systems. Accordingly, AI systems must be technically robust and secure, and privacy protection and data quality management must be guaranteed. Transparency (including traceability, explicability and communication), diversity, non-discrimination and fairness, as well as social and environmental well-being and accountability must be ensured. These seven requirements are interrelated, fundamentally equal and, in the opinion of the authors, must be considered in the specific context of any application. They are also significant for the entire life cycle of an AI system and should, therefore, be subject to continuous assessment and consideration (Pekka et al. 2018).
- Building on their review of learning analytics for VET, Ifenthaler and Yau (2021) derived several recommendations for action (not specifically focused on the ELSI aspects) and called for a comprehensive change process in all organisations involved in their implementation in VET. The stated eight recommendations for action address not only ethical, legal and social aspects but also the organisational, technological, and pedagogical aspects associated with the use of LA. In addition, the recommendations for action include, in particular, a robust quality assurance process, research funding and accreditation in the context of LA in VET (ibid. p. 225).
- Gressel (2019) has considered seven ethical principles: Dignity, Autonomy, Privacy, Principle of Harm Avoidance, Justice, Responsibility Sharing, and Acceptance and Acceptability to be central to meeting the ethical challenges in the reference field of research on and with VR and AR. Gressel's demand for autonomy is about the participants being able to participate consciously and self-determinedly in the research process, and being sufficiently informed about the research and development goals. Against the background of the potential possibilities for collecting and analysing extensive personal data through VR and AR, the privacy of the participants is in fact restricted in the opinion of the author. In addition to the relevant legal regulations and principles of data protection (including the principle of data minimisation), the participants must also be comprehensively and clearly informed about the collected data and analysis options before the data is collected. With regard to the principle of harm avoidance, several appropriate measures to minimise harm should also be taken (e.g. minimisation of motion sickness effects through the use of teleportation). While the principle of justice addresses target group-related inclusion and exclusion mechanisms, in

> an individual project a transparent and legally clear distribution of responsibilities between the participants must be outlined.According to Gressel (ibid.), signs of acceptance can be described as a combination of attitudes and behavioural intentions or the actual behaviour of persons towards a situation, an object or a person (Schwarz & Chin 2007). With regard to the acceptance of VR, it was determined in the own research group (Pletz & Zinn 2018; Pletz 2021) that the perceived usefulness and user-friendliness of virtual environments have a central influence on the users' intention to use them. Teachers should therefore be convinced of the usefulness and usability of virtual teaching and learning environments and, be involved in the development and testing process at an early stage. According to Gressel (ibid.), acceptability is a normative corrective that helps to evaluate the actual acceptance behaviour of users from an ethical point of view. In order to examine the acceptability of risks, all (conceivable) consequences of a certain technology and its specific use must be included in the ethical evaluation. Subjective feelings (e.g. a person's fears about the recording and analysis of their individual data in the context of a movement profile) must also be included in the evaluation, even if it seems irrational (Birnbacher & Koch 1983, p. 496).

To what extent ethical guidelines, principles, and values are actually implemented in the practice of research, development, and application of AI systems is the subject of Hagendorff's criteria-based analysis of 22 ethical guidelines from various areas of society. Hagendorff notes that currently, ethical guidelines on AI are often not applied as intended and primarily serve as a marketing strategy. Moreover, empirical studies show that knowledge about ethical guidelines has no influence on the decision-making of software developers and that software developers lack insight into the moral significance of their work. As a result, the purposes for which AI systems are developed and applied are not in line with societal values or fundamental rights such as beneficence, harmlessness, justice, and explicability (Hagendorff 2020, p. 113f.). Hagendorff therefore calls for action-limiting ethics, based on universal principles and rules, to be developed further into situation-sensitive ethics, based on virtues and personality dispositions, knowledge enhancement, responsible autonomy and freedom of action. However, he is not concerned with disciplining the participants in such a way that they adhere to ethical principles, but with emancipating them so that they can make morally relevant decisions themselves (ibid, p. 114).

As an interim conclusion, it should be noted that despite the contextual specificities in the contributions by Ferguson (2016), Pekka et al. (2018), Ifenthaler & Yau (2021) and Gressel (2019), the individually raised considerations as well as the specifically focused technology, and despite all the conceptual vagueness (with objectives, ethical guidelines, recommendations for action and ethical principles), there is also a consensus in terms of content in the contributions (Table 1). Across the contributions, recognised social values and norms such as respect, trust, security and privacy play a central role. At the same time, it is clear from the overview of the content-related aspects presented in Table 1 that all authors are also concerned with orienting the development and application of the respective digital technologies to the individual needs and specific situations, as well as its acceptance amongst all participants. This is an aspect that Hagendorff also addresses with his "situation-sensitive ethics" (Hagendorff 2020).

Tab. 1: Overview of the content aspects

Authors	Technologies/ Context	Content-related aspects of dealing with digital technologies
Ferguson (2016)	LA/ Ethical objectives	1. educational success 2. trustworthiness of the educational institution 3. respect for private and group values 4. respect for property rights 5. teachers and educational institutions can protect students 6. realising educational justice 7. fair laws that are applied and respected equally 8. freedom from threat 9. personal integrity
Pekka et al. (2018)	AI/systems throughout the life cycle	1. primacy of human action and oversight 2. technical robustness and security 3. data protection and data quality management 4. transparency 5. diversity, non-discrimination and fairness 6. social and environmental well-being 7. accountability
Ifenthaler & Yau (2021)	LA/ Vocational education and training	1. flexible, needs- and organisation-specific orientation 2. building organisational, technological and pedagogical structures and processes 3. involvement of all stakeholders 4. definition of requirements for data and algorithms 5. information/education of all stakeholders on ethical and data protection conditions, standards, privacy protection, data protection, and compliance with ethical aspects 6. robust quality assurance process 7. research 8. committee formation/accreditation
Gressel (2019)	MR/ Living Labs in health and care settings	1. dignity 2. autonomy 3. privacy 4. principle of harm avoidance justice 5. distribution of responsibility 6. acceptance 7. acceptability

5 Summary

In a techno-ethical consideration of the initial topic, it is evident that the positive and negative effects of the use of digital technology cannot be separated from each other. At the same time, it should be noted that when technology is used, the seperation between the action and the consequences of the action is usually greater and the extent of the effects greater than with simple, interpersonal actions (Jonas 1993). If one also assumes the Collingridge dilemma[1], there is an obligation on all those involved to assess the consequences of the use of digital technologies in education as best as possible and possibly also to apply the principle of "in dubio pro malo" (Jonas 1987, p. 72). However, if these assumptions and principles are applied in an overly conservative manner, there is a latent danger that the potential of digital technologies listed in the second section will be limited to such an extent that their teaching- and learning-promoting effects will no longer be harnessed in the complexity of teaching.

The use of digital technologies and their actual strength of influence on teaching should be considered more comprehensively in terms of technology and application. In the field of digital media in education, the Committee on Education, Research and Technology Assessment has called for ethical and data protection issues to be taken into account at an early stage of technological development (Autorengruppe des Ausschusses für Bildung, Forschung und Technikfolgenabschätzung 2016, p. 132). The currently funded development and research projects (e.g. BMBF 2020; Stiftung Innovation in der Hochschullehre 2020) in the school and university education sector around MR, AI, and LA could be used to further develop the ELSI topic in terms of content and advance it in the sense of "innovations in research and teaching".

In order to constructively consider ELSI of the use of digital technologies in education in a multi-perspective manner, the content-related aspects regarding the use of digital technologies (see Tab. 1) described in the fourth section can be of fundamental importance with respect to a participatory research approach. In participatory research, where its field of application also includes school and classroom research (Unger 2014; Bergold & Thomas 2010), users are actively involved in the research process at an early stage, in addition to the developers and researchers. The participatory research approach can be expected to ensure that those about whose educational situation or learning and working methods one wants to know something are directly involved in the development and research. The participation of different groups (including users, researchers, teachers, and learners) and their individual perspectives can thus ultimately help a better understanding of a digital educational environment and to arrive at a profession-oriented use of the new "innovative technologies" to be obtained. This can be achieved through the jointly gained experiences in the development and testing of digital technologies. It should be borne in mind teaching is complex and the quality of a teaching and learning arrangement is, besides by the use of digital technologies, determined by many other influencing parameters (including the teacher, the learners, the framework conditions, etc.).

Finally, it can be summed up that in view of the size of the initial topic, this editorial does not claim to systematically deal with the manifold aspects of the use of digital technologies and their ethical, legal, and social implications in education - nor was this intended. Moreover, even if critical aspects of digitalisation were thematically in the foreground of this contribution, these aspects should not lead to a negative attitude towards the use of digital technologies in teaching and research. Rather, the intention of this article is to invite readers to engage in constructive discourse and a differentiated consideration of teaching using new digital technologies and to provide them with starting points for dealing with ethical, legal, and social implications in their field of reference. The digital technologies addressed in the article, MR, AI and LA, contain diverse innovation possibilities that should be used in a profession-oriented manner for initial and continuing vocational education and training, as well as for higher education. By incorporating digital technologies such as MR and AI, it is possible to make vocational education and training, and work fit for the future, as well as provide a significant contribution to sustainable value creation.

[1] The Collingridge dilemma states that firstly, before deciding to use a particular technology, the effects cannot be easily predicted and after using a technology, it may be too late to avert undesirable (educational) consequences (Collingridge 1980).

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