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DOI

[10.3390/educsci12110754](https://doi.org/10.3390/educsci12110754)

Publication date

2022

Document Version

Final published version

Published in

Education Sciences

Citation (APA)

de Vries, P. (2022). The Ethical Dimension of Emerging Technologies in Engineering Education. *Education Sciences*, 12(11), Article 754. <https://doi.org/10.3390/educsci12110754>

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Article

The Ethical Dimension of Emerging Technologies in Engineering Education

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Abstract: Emerging technologies are part of the constituting datafication and digitalization process that poses major challenges to the current educational infrastructure. Clearly, universities are challenged to respond to the demands that seem to develop faster and become more complex over time. The complexity, though, is not just technical; it is the combination of technology, and specifically big data use, with job requirements, educational practices, ethical responsibilities, and the socio-cultural aspects of education. The purpose of this paper is to analyze and discuss elements of these issues in trying to clarify the complexity and lower the threshold for those who are involved and to look for a better understanding of the opportunities and challenges. Therefore, different issues related to emerging technologies are discussed, with a focus on big data and artificial intelligence, as core technologies, followed by the impact of the COVID-19 pandemic as a societal development, the EdTech industry, and all the ethical dimensions of the technological change and the consequences for education. Ethics have been shown to be of value, also, in times of increasing complexity and can guide the use and development of emerging technologies in higher education.

Keywords: engineering education; emerging technologies; datafication; COVID-19; EdTech industry; ethics tech



Citation: de Vries, P. The Ethical Dimension of Emerging Technologies in Engineering Education. *Educ. Sci.* **2022**, *12*, 754. <https://doi.org/10.3390/educsci12110754>

Academic Editor: Brian M. McSkimming

Received: 4 September 2022

Accepted: 22 October 2022

Published: 27 October 2022

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1. Introduction

Universities play an important role in preparing engineering students for their prospective jobs which increasingly rely on digital skills for handling new and emerging technologies. These technologies are not yet widely adopted but are substantially present in the business environment and our society, while at large they are considered crucial for development and innovation. In higher engineering education (HEE), these technologies are increasingly used as subject matter and tools for improving (engineering) education but have not been successful as accelerators of educational innovation. The most prominent technologies are big data, data analytics, artificial intelligence, IoT, robotics, and virtual realities, which are mostly used in HEE as subjects and applied to facilitate learning in combination with hardware, software, educational theory, and changing educational practices [1].

The purpose of this position paper is to discuss the changing context of HEE with the emergence of these new applications and technologies used as subjects and tools for education. We then specifically look at a few related dimensions of concern which in combination play a dominant role, such as the consequences of increased datafication due to these technologies, the effects of COVID-19 on education, the related role of the EdTech industry (educational technology industry), and the need to consider the ethical dimension of this development to improve guidance in this overall complicated development.

Emerging technologies have been applied, studied, and discarded in the last decade in the context of educational innovation. This has been a rather unproductive and sometimes painful process, with Massive Open Online Courses (MOOCs) as a development receiving lots of attention but not being a profound factor of change. Educational technology, though,

has moved from a niche concern to one of the most significant aspects of contemporary education and learning. Not because it has been proven that it works; on the contrary, it is raising new problems in need of research [2]. This is partly due to the reluctance in education policy to embrace the opportunities supplied by emerging technologies as technological advancements [3]. This has allowed EdTech companies to start using social media and more dedicated platforms for educational purposes with data as their main orientation to prove that their approach has worked. Then, the emergence of COVID-19 forced universities across the globe to shift to fully online delivery as campuses locked down. For most institutions, this meant a swift move from the face-to-face teaching model to the 'Zoom classroom', which in most cases was a replication of on-campus delivery in an online environment, with timetabling and synchronous online instruction using PowerPoint presentations and the like. For others, more familiar with online education, the pandemic situation meant upscaling content, synchronous and asynchronous delivery, and the need for more online course content [4].

The switch to online and digital education formats on a worldwide scale made education an emergency matter, with educational technologies in the frontline. For some, technology seems to be the remedy for 'emergency remote education'. Clearly, these technologies have provided tools and resources to enable educators to make the switch to online. At the same time, this pandemic pedagogy has led actors in the EdTech industry to treat the crisis as a business opportunity, with potentially long-term consequences for how public education is perceived and practiced [5]. No doubt, some reflection is needed, because such technologies have broader effects on education than just practical online connections. It is the educational context and the related ethical dimension of the use of emerging technologies that can help to achieve better judgements and develop guidance. Ethics has proven to function as a framework for ethical judgement and to recognize problems and support guidance in the development process of engineering education. Engineering ethics is, then, a set of rules and guidelines that engineers adhere to as moral obligations, with the potential to support social accountability and serve as a source for sharing ideas and knowledge about such relatively new developments as emerging technologies in engineering education. In this sense, ethics seem to develop as a design tool to cope with day-to-day educational activities, decision making, and policy making [6].

2. Materials and Methods

This position paper is based on a review of the scientific literature, existing practice guidelines (if applicable), consensus opinion among a multidisciplinary group of authors, workgroups, special interest groups, such as at SEFI (www.sefi.be), newspaper articles, weekly magazines, etc. The resources, though, also comprise a selection of social media platforms, such as Facebook, Twitter, WhatsApp, podcasts, and others, as part of a mix that allows coverage of the scientific but also other timelier resources and should serve to raise awareness and motivate the reader to explore the emerging technologies topic for relevant issues.

Important drivers of the use of emerging technologies are the changing demands for skills and, in particular, the shortages of digital and technological skills in the engineering field. This also applies to the changes in the way work is carried out, which is raising the demand for 'soft skills', such as communication, self-direction, and problem solving [1,6]. Emerging technologies in education are often perceived as capable of changing the existing situation faster and better than other measures given the radical novelty. Results, though, are somewhat uncertain and ambiguous because a learning environment is a complex system of interplay, interactions, and technology that can alter the pedagogical setting and learning concepts, which is risky without adequate research validation [7]. In this context, it is not valid to assume that technology is neutral, also, because the application is clearly connected with emerging new and changing educational practices. Therefore, it is important not just to consider the advancement of technology in education but to look closely at the social and human consequences. In practice, teachers and students have

been engaged with a large variety of emerging educational practices, such as MOOCs, open educational resources, flipped classrooms, and micro-credentials, which means that ‘emerging technologies’ applied in education also include other, new concepts and innovations with different pedagogies and advancements which can be qualified as emerging practices [8]. This also means that teachers and students are confronted with design choices and decisions of various kinds which might be dominated by digital technology rather than pedagogical arguments, which could lead to the removal of non-digital technology and even the replacement of books, notebooks, and paper with digital technology equivalents.

The digital transformation is omnipresent in the industry and the business world through the profound integration of digital technology into all areas of business, and is fundamentally changing the operations and delivery of value to customers [9]. This development can be observed in educational business, which is not necessarily the same as development and operations in the educational field. The development of 5G networks in relation to education is an example of how this can work out in practice. The purpose of 5G is to reduce or remove limitations of bandwidth and access, creating new networks. This affects organization as well as existing workflows, and creates new ones, forcing many industries to transform, and will also impact the work and the work environment and what and how learning takes place.

In this regard, UNESCO started a Futures of Education initiative [9] focusing on educational renewal, with the aim of rethinking education and shaping the future. This comprises a global debate on how knowledge, education, and learning need to be reimaged in a world of increasing complexity, uncertainty, and precarity. This, certainly, is an important initiative, but not all educationalists are happy to see such a large organization discussing and deciding the future of education, even if the intention is not to present a fit-for-all solution or policy [10,11].

2.1. Big Data

Dealing with data in the educational context is different from the business field, as can be shown by the role of big data in higher education. Data storage and exchange is key for any organization, but the needs of higher education can be very different compared with commercial business entities. Education produces and needs vast volumes of research data, multiple levels of access, and sharing and editing possibilities, and must cope with institutional and private sensitive information on students, faculties, and research. How data are used depends on what the data reveal and who collects them. The tendency in higher education is to increasingly collect data about individual teachers and learners to gain a better sense of the situation regarding organizational needs, performance, job needs, teacher needs, study needs, behavior, and future outlooks. Therefore, the spectrum of big data has enlarged significantly and comprises educational data science, learning analytics, computer adaptive testing, assessment analytics, educational data mining, adaptive learning platforms, new cognitive systems for learning, and even educational applications based on artificial intelligence are quickly becoming parts of the educational landscape, in schools, colleges, and universities, as well as networked online courses [12].

Clearly, the era of big data has begun, and surely large-scale search data will help to create better tools, services, and public goods. Or will big data lead to a new wave of privacy incursions and invasive marketing? Boyd and Crawford [13] have already argued that big data, as a socio-technical phenomenon, needs to be critically interrogated with respect to its assumptions and biases. Therefore, it is necessary to ask critical questions about what all these data mean, who is able to access what data, how data analysis is deployed, and to what end? Looking at the future of education through the conceptual lens of big data stimulates a particular way of thinking and visioning education. The tendency is, then, to look at education as an ‘information-processing’ activity and treat learning as something that can be monitored and optimized based on digital processes, ignoring the social, cultural, political, and economic factors that structure education and individuals’ experiences of learning [14,15]. Big data could be part of an improvement

or a solution but must have educational value in supporting demands and requirements from education, such as the levels of security and compliance, balanced workflows, and capacity requirements.

2.2. *The Role of AI in Education*

One of the most encompassing emerging technologies is artificial intelligence (AI). This technology drives machine learning, neural networks, natural language processing, and multiple other technologies. AI enables image and language recognition, searches, autonomous vehicles, predictive algorithms, smart machines, connected devices, and literally thousands of gadgets and apps. We all use these, while mostly not being aware of the presence and role of AI. Clearly, AI is used to augment human capabilities, and it has a major impact on how we live, learn, and work. The advancement in technological innovation is prominent in the industry and society, but in training and education AI seems to be only in the early stages of development [16].

As already indicated, there is a lack of technical skills for emerging technologies in general, but the shortage of AI application skills could especially limit people's abilities to participate in society and compete in the labor market. The urgency of developing foundational knowledge about preparing students and the workforce to thrive in an AI world is evident. AI has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and ultimately accelerate progress towards the Sustainable Development Goal 4 on Education [17]. However, these rapid technological developments inevitably bring multiple risks and challenges, which have so far outpaced policy debates and regulatory frameworks. This growing bond between AI and education presents opportunities and risks that need to be addressed. Of help is the guide recently published by UNESCO covering definitions, techniques, and technologies, giving a detailed analysis of the emerging trends and implications of AI for teaching and learning [10]. Clearly, a profound reflection is needed on how to ensure the ethical, inclusive, and equitable use of AI in education and on how education can prepare humans to live and work with AI, as well as how AI can be applied to enhance education.

The impact of digitalization in higher education has been studied for at least three decades, with the focus on online tools for communicating, teaching, and learning in an electronic environment. The development has been slow and fragmented compared to the expansion in the business world and our day-to-day use of the smartphone as a dominant tool in normal life. A transition to online, as predicted by the early adopters, did not happen, although the use of social media and other generic applications not particularly developed for education were enthusiastically adopted and used by teachers and students alike, without really changing educational practices [18,19].

2.3. *COVID-19*

The COVID-19 pandemic forced education into a sudden transition to online learning, which meant that online became a reality overnight for most teachers. This global rapid shift to online delivery in higher education resulted in students and teachers feverishly trying to cope with the reality of a new learning environment that affected students and teachers and the educational organization at large with changing roles, although most online teaching and learning followed the familiar pattern of teachers talking and students listening [20]. Later findings showed that other narratives developed, such as improved participation and exchange, self-regulation, project-based learning, and suchlike, which was, for both students and teachers, challenging in terms of trying to adjust to a new educational experience [4]. The core challenge seems to be the repositioning of the student and teacher roles in a new educational ecosystem, which needs to be understood and managed to gain maximum benefit from this rapid and unprecedented change. During this period, it was observed that the transformation of educational practices led to a better understanding of the role of digital technologies in education, and this provided

an interesting practical test of the techniques and theories that had been developed. As a result, some of them have proven their viability and effectiveness, while others have not [4].

2.4. *The EdTech Reality*

In the last decade, there has been an explosive development of new educational applications, mostly based on the opportunities offered by emerging technologies, such as AI. The EdTech industry is actively marketing these teaching and learning tools to all levels of schools and other educational institutions, although the efficacy of technology-enhanced learning is still under investigation [21]. The international EdTech industry has been very instrumental in promoting digital systems for management and pedagogy with the help of political influence and investor support [5,7,11]. Very promising and attractive for education was the level of information these instruments could deliver for management and pedagogical purposes. This has not been very visible, in the sense that one could not see robots performing tasks; the AI development arrived in an inconspicuous form, though this does not mean that the impact was not significant. The EdTech industry has introduced new algorithmic capacities for learning analytics, artificial intelligence, and automation in schools and other educational institutions' classrooms through digital platforms. It is obvious that algorithmic systems increasingly pervade the educational and social sphere, providing improved efficiency which increasingly leads to mass integration into day-to-day life, including education. However, research in algorithmic injustice shows that algorithmic systems, especially when used to sort and predict social outcomes, are not only inadequate but also cause injustice and harm. Algorithmic systems offer solutions that are predominantly technical solutions and have impacts that can be selective and judgmental [22]. Birhane [23] therefore proposes a fundamental shift—from rationality to relationality—in thinking about personhood, data, justice—in short, everything, when it comes to the application of algorithmics. This basically means that universities must know that the use of these technologies requires, among other things, safeguarding data and an understanding of users' sentiments and values when creating student-facing systems, which requires diversity in design teams.

The EdTech reality is not just about services and platforms. Companies such as Amazon, Google, Microsoft, Salesforce, Verizon, JPMorgan, and Accenture are creating new programs to upskill their workforces, and from there it is only a small step for these corporate giants to create a parallel postsecondary universe that eventually could even replace traditional higher education [1]. More specifically, Google has plans to bring in AI with the ambition to transform education. The extension of Google in education has been controversial over the years because the practice of collecting and data mining personal information from Chromebooks and Google apps for education without permission, as was discovered and clarified by researchers from the University of Boras, underlines the doubtful role of the privacy policy hidden in its business model [5,11,24].

More things have happened, though, that are indicative of the increasing role of EdTech in education. Recently, Facebook (now Meta) announced that it was to become a partner with Coursera and edX to help push Meta's curriculum in augmented and virtual reality. EdX, which was founded by Harvard and MIT as a non-profit organization, is in the process of being sold to a for-profit organization. What we know about Facebook is that the organization denies accountability for misinformation, climate denialism, and harmful effects on teenagers, and that, apart from other negative influences, it has played a doubtful role in Myanmar and Ethiopia [25]. The Facebook policy is said to put profit before people, which makes it a doubtful partner for education. The EdTech trends are, on the one hand, developments that can support and enable the innovation and improvement of education; on the other hand, they show a concentration of technological development capacities and finances in the hands of a few, causing irregularities which can be blamed on one-sided business models. Meanwhile, though, an increasing number of scientists and researchers are aware of and involved in scrutinizing the developments and add to a more balanced analysis of digital education, including the role of the EdTech sector.

An example of this involvement is the conference ‘Digital education governance beyond international comparative assessment’ organized in 2022 by the Centre for Research in Digital Education at the University of Edinburgh, which mentioned three major transformations that are at stake: ‘a *structural* shift in the organizations, actors and expertise involved in the governance of education; *new techniques* to govern, control, steer, enable or constrain education systems, institutions, populations and individuals; and *changing forms of agency and authority*, which make governance more pervasive and challenge the relationship between public and private’ [26]. Another example of the upcoming involvement and desire to correct big tech was the acceptance of the Digital Services Act (DSA) by the European Parliament [27]. The European Parliament wants users of platforms, such as Google and Facebook, to be better protected. The bill demands more transparency about tech company algorithms that generate search results and newsfeeds. Companies are required to report on the risks of fake news and disinformation. So, governance actions are taking place, but for the day-to-day reality in education this might not be enough. Institutions themselves need to develop the alertness needed to cope with the peculiarities of big data and EdTech and take the responsibility and ownership to deal with it [19,28].

2.5. The Ethical Dimension

Engineering education has a strong tradition in practicing ethics as one of the most important soft skills for students and professionals. Such codes of ethics for decision-making policies and values are desirable in engineering practices, and research plays an important role in establishing accountability. The swift changes and upcoming datafication and market developments in education seem to ignore ethics as a guiding principle [29]. Online teaching and learning have added over the years another dimension to the spectrum of educational practices in HEE. Although the adaptation and implementation have been a slow process, the added value has been recognized but is hard to prove on a broader scale to convince other teachers and educators, despite their being active users of social media. An important reason for the pace of the process is the fact that emerging technologies are ‘contextual, adaptable, evolving, ubiquitous, disruptive, innovative, complementary and generate a degree of uncertainty’ [29]. In other words, there is a high degree of complexity to deal with, and institutions have difficulties in adhering to such a demanding change in performance, including the view on the role of ethics.

One development which has been considered successful is the appearance of Massive Open Online Courses (MOOCs), although the success has been limited to a particular group of Western universities. The development started with the creation of online courses for anyone with an internet connection and evolved over the years into a myriad of online products and business models that have made lots of people happy. The MOOC development, though, has another dimension which is related to the way educational institutions have dealt with online education so far. Enrolling thousands of students was considered a great achievement, but failing to ensure that they could succeed was rather irresponsible. Online and on-campus learners are quite different, with online students being older, having different responsibilities, such as families to care for and demands at work, but lacking academic support to attain their achievements. In addition, most MOOCs did not lead to a valid certificate at university level. This has since changed for the better, but it is still essential to realize that, for all students, online education carries a clear requirement of ethical accountability on the part of educational institutions.

Universities increasingly depend on the educational technology industry (EdTech) as service providers offering learning management systems, tools, and services for the development and maintenance of products, such as MOOCs, and for the extensive use of online teaching and learning in daily educational practice, including administrative tooling. Universities were not prepared and not equipped and had virtually no possibilities to develop the technical infrastructures themselves, and the lack of experience in online learning created the opportunity for others to join the endeavor. The load of the development of courses and their execution was on the side of the institutions, certainly in the beginning

of the development, but the rest was successively supplied by early adopters, including for-profit initiatives, such as Coursera and Udacity, and primarily non-profit initiatives, such as Edx (an initiative of Harvard and MIT). Now, the initiatives are increasingly being taken over by the for-profit EdTech industry, which has developed as a conglomerate of educational services. Research shows that while most attention was paid to this handful of US-based providers, other developments were taking place, such as those presented by Ruipérez-Valiente [30] in a study of 15 different MOOC providers with more than 8 million learners, showing that Regional MOOC providers attract larger local populations, with more inclusive demographic profiles, and that these providers might be better-positioned to fulfil learners' needs. This is an indication that diversity will also be a factor to deal with.

As the industry is focusing on the datafication and profitability of commercial endeavors, education plays another role. Education can significantly use data, AI, and smart IT systems, but technology is value-laden and therefore elements such as accountability, fairness, safety, inclusiveness, and other ethical values play important roles that connect with the vast tradition of engineering education, with ethics in teaching and in the professional field.

3. Results

The discussion and analysis of the emerging technologies field has been narrowed down in this paper to a few issues which are firmly related to the current situation in higher engineering education. The topics are: the framing of emerging technologies, with a focus on big data and AI as the most influential factors in the datafication and digitalization process in the industry and education, the influence of COVID-19, the EdTech reality, and the ethical dimension as a crucial element in the analysis of emerging technologies in engineering education.

Emerging technology use in engineering education is, on the one hand, a subject matter in teaching and learning and, on the other hand, a tool for digital education. The subject approach is firmly related to the idea that students will be better prepared for the demands of the labor market, although there is always the question about how this education can be made more effective. Emerging technologies are being characterized by complexity, diversity, and speed of development and decay, which requires good understanding to decide their value for education and make their use a profitable endeavor. The same is true with regard to their use as tools for learning. Teachers need to be prepared to investigate, test, and assess the usability of these technologies, mostly packaged as learning management systems and administrative tools, in their micro-environment of teaching and learning to see what the added value is. This cannot be a one-person act because of the complexity and the knowledge and skills required to develop teaching and learning practices that optimize the use of such technologies [17,19].

The COVID-19 pandemic caused many universities to migrate most of their courses and services to online environments. This prompted higher educational institutions to quickly change their digital education strategies. The digital campus was activated overnight, which meant a transition of the classroom context to an online environment in which teachers and students were confronted in most cases with an online version of the in-person classroom context. This change of environment almost immediately called into question the efficacy of delivery to varying student communities. Institutions started to realize that the diverse student body was engaging with the digital environment in different ways. In addition, teachers showed different digital and online engagement patterns, which clarified that a one-size-fits-all approach does not always work. So, institutions learned that diversity and heterogeneity need to be recognized if higher education wants to engage successfully with digital education. This means that re-visioning of knowledge, education, and learning is becoming more relevant than ever [3].

The pandemic certainly has caused a more rapid technological development and transformation in digital education and has increased the deployment of AI, which will have a profound implication on the future of education. As not just AI-based tooling plays

a role, the question of what AI skills will be commonly beneficial for education must also be asked. Defining these skills will be part of policies and practices regarding the competences and strategies needed to prepare users to live and work with AI effectively. In response to this future orientation, the tech industry, academia, civil society, and governments have rapidly increased their attention to ‘ethics’ in the design and use of digital technologies (‘tech ethics’). This upcoming ethical approach has clarified that technology is not inherently a good thing and that a firm ethical discourse is needed across the world of digital technologies. At the same time, though, ethical approaches show limitations, in the sense that tech ethics can be vague and toothless in the field of corporate logic and incentives and is overly focused on engineers and technology rather than on structures and cultures of technology production. As a result, tech ethics is confronted with skepticism that has led to the accusation of ‘ethics-washing’, which is the use of ethics research to fight criticism and regulation. So, positioning ‘tech ethics’ to clarify what it entails and who will define it is becoming a major task [6].

4. Discussion

Emerging technologies are often perceived as capable of changing the existing situation faster and better than other measures, given the radical novelty. This is certainly true in the industry and business, but education so far has shown a reluctance that is based on the underestimation of a needed future orientation of education. The discussion about what education could be like in the future is very much concentrated on the future of institutions. With the emergence of new technologies, such as big data and IT, this limited view and discussion is losing ground, and with the changes forced by the pandemic, the future discussion seems to gain more relevance. An important reason for this is that the increasing use of technologies also requires a view on the financial future and speculation on education and the risks involved. In that sense, there is a need to review how and what education should be like in the future using a much broader frame of reference [26]. The current discussion, as reflected upon here, is predominantly focused on emerging technologies, lacking a broader view on technology in the context of education, being confronted with the pandemic, EdTech developments, and the role of techno-ethical discourse.

In essence, technology in education forces us to think differently, but this cannot be limited to the conceptual lens of big data. Learning is more than an information-processing event—something that can be monitored and optimized like a computer program [31]—and it seems that much contemporary research on educational technologies and media is fixated on solving problems and offering evidence of ‘what works’. This implies an oversimplification, suggesting that education needs to adapt to AI and automation to ‘robot-proof’ students for future jobs. Automation is a major challenge for education systems, but it should also be understood as deeply contested rather than inevitable [28]. At the same time, the ethical stakes of education technologies that process sensitive student data and personal information have never been so acute. Issues such as the spread of surveillance technologies [32] and the difficulties in securing student anonymity [33] are raising new ethical, legal, and regulatory challenges, and a growing community of various groups, from educators to policymakers, are addressing these issues.

An example of this development is how the European Union is dealing with the controversy regarding the interests of their citizens and the superpowers in Silicon Valley. Those companies increasingly base their business models on using private data to attract advertisers. In February 2022, the people’s representatives in Strasbourg adopted the Digital Markets Act (DMA), which is intended to curb the near-monopoly power of big tech. This act focuses on the discontent over the invasion of privacy, the monopolization of the digital world, and the polarizing effect of algorithms, for example, their application to hold the attention of users for as long as possible, as practiced by Facebook and YouTube. In the fall of 2021, Facebook whistle-blower Frances Haugen said, during her testimony in the American congress and later before the European Parliament, that the company

provides as much 'angry, polarizing, divisive' content as possible 'because that makes more money'. In her view, Facebook broke the law [25].

Such testimonies as that from Haugen function as wake-up calls, not just stimulating discussion but also clarifying what is at stake. The message is that the business policy of the tech sector does not seem to be in line with the educational context and needs. This also clarifies that education cannot stick to a one-sided focus on educational primary processes. Zuboff, in her book on surveillance capitalism [34], describes the new emerging political economy as applied by the tech sector as the overlapping of technology, business, and politics. The issues at stake are human lives, personalities, bodies, and emotions, which all have become subject to proliferating techniques of data 'rendition'. This book was an eye-opener for a large audience about the practices of companies and businesses of profiling users, targeted advertising, 'personalized' services, and even 'micro-target' political messaging, with the aim being to amass commercial profit and mobilize corporate lobbying power to bend laws and regulations to their own interests. This certainly is not the first or the last time that organizations have put their own interest first, but the consequences are far-reaching for education. According to Zuboff, this power wielded by big platform companies and businesses has affected education significantly in recent years [34].

5. Conclusions

The aim of this position paper is to encourage HEE, including policymakers, educators, researchers, administrators, and students, to think critically about the datafication and digitalization of education, in which emerging technologies play such an important role. These technologies are key to the pressing challenges regarding big data use in the current educational infrastructure, educational practices, ethical responsibilities, and socio-cultural aspects of education. HEE cannot ignore these issues, certainly not now the pandemic has forced us all to go digital rather quickly. In the past, education was overwhelmed by the promises of learning technologies, but now there is much more at stake than just educational innovation. Engineering education needs to get ready to decide about the value for education of these technologies, better understand the possibilities and limitations, develop better judgment about the educational technology industry involved, and define and apply the ethical dimension along with the development of techno-ethical auditing practices. Future thinking about education has a different spectrum from that which it previously had because of the intrusive diversity and complexity that requires at all levels the development of a coherent view of the possibilities and limitations.

One of the emerging technologies that has been discussed is artificial intelligence, the reason being that this technology has positioned itself over time as a herald of transformation through its impact on humanity. AI has impacted sectors such as defense, banking, and healthcare, but education has remained relatively untouched in terms of classroom and day-to-day practices. Given the prominence of this technology and its intensive use by the EdTech industry, it is inevitable that educational practices will be impacted and eventually influenced by AI. An important question is how to engage with AI and handle its impact on education. Thinking about consequences will shape the future of education and will not be without consequences. The ideas of the future that educators, policymakers, teachers, and students have will shape assumptions about the present and the years to come and will justify investments and behaviors. Ideas about the future in education matter because these ideas fundamentally shape what we think education is and should be. The ethical dimension must be part of this process of thinking about futures in education to assure a grounded plea for accountability for all.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

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