International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 7 Issue 4, April - 2023, Pages: 7-21

Delving the effect of Artificial Intelligence in Education

Mrs GLADYS Nwakaego Obimgba PhD

University of Delta (UNIDEL), Agbor. Faculty of Education, Department of Science Education
Computer Science Education Unit
+2348035515314
obimgbagladys5@gmail.com; **gladys.obimgba@unidel.edu.ng**

Abstract: Artificial Intelligence (AI) and Robotics are likely to have a significant long-term impact on Higher Education (HE). The scope of this impact is hard to grasp partly because the literature is soloed, as well as the changing meaning of the concepts themselves. But developments are surrounded by controversies in terms of what is technically possible, what is practical to implement and what is desirable, pedagogically or for the good of society. Design imagination that vividly imagine future scenarios of AI or robotics in use offer a means both to explain and query the technological possibilities. The paper describes the use of a wide-ranging narrative literature review to develop eight such design imagination that capture the range of potential use of AI and robots in learning, administration and research. They prompt wider discussion by instantiating such issues as how they might enable teaching of high order skills or change staff roles, as well as exploring the impact on human agency and the nature of digitalization.

Keywords: Artificial Intelligence (AI). Higher Education (HE).Digitalization. Desiginagination.

Introduction

In recent years, the public, government, and academia have all shown a keen interest in how robots and artificial intelligence (AI) may change the course of human history. Higher Education (HE), like every other area of life, will be impacted, maybe profoundly (Bates et al., 2020; DeMartini and Benussi, 2017). HE needs to change in order to prepare people for a new economy and perhaps a new way of life. AI and robotics are also likely to affect how education is offered, including how individuals learn, what professors and researchers do, and how universities operate as organizations.

The introduction of AI and robots will not be a straightforward process without difficulties and ironies (Reid, 2014). Also, there is a long history of critical responses to technology in HE in the literature on education. They frequently center on problems like how technology could dehumanize the educational process. They are frequently motivated by neo-liberal ideology encased in technology or a fear of commercialization. AI and robotics are the subject of related debates. The automation of HE is the subject of a lot of criticism. In light of this, there are ethical and practical concerns around the employment of AI and robotics. 2019a Selwyn. Most contemporary research on AI in learning is computer science-based, and it appears to ignore both pedagogy and ethics, (Zawacki-Richter et al., 2019). AIEDresearch acknowledged to have a WEIAD (Western, educated, industrialized, affluent, and democratic) bias (Blanchard, 2015).

Imagination, has capacity to aid creation of alternate realities, as a tool assisting us understand the usage of AI and robotics. Science imagination has significant effect on molding. Science imagination has long been fascinated with AI and robots, probably because they improve or represent the mind and body, which define humanity. A burgeoning field of research in Human Computer Interaction (HCI) investigations use speculative accounts to undermine presumptions using "design imagination" (Blythe 2017). A mixture of design, science fact, and science imagination are able to raise important queries on how AI affects society and to actively include larger audiences in the creation of technology,(Bleecker,2009).

The approach holds promise for easing the process that understands how robotics and AI will affect HE. This research describes the creation of design imaginations to broaden discussions regarding the quality effects of AI and robotics on HE, arising from comprehensive historical literature review. The design imagination method will be explained in this paper.

Method of design imagination

While picturing the future, we employ a range of imaginations.
Strategic planning and studies conducted employ situations, being essentially imaginary tales, to depict competing prospective possibilities (Amer et al., 2013; Inayatullah, 2008). Partners utilize this combination to choose the most appropriate approach.
On a more pragmatic level, vintage models are short stories utilized during the systems design process to illustrate how a designed technology could be applied to solve issues in the physical realm.

These situations are fundamentally narratives which highlights that system design is by nature a productive endeavor (Blythe, 2017).
They are frequently used to include partners in systems engineering. Its
benefit is the forced introspection beyond the restrictions of attempting to create a system that simply works (Carroll, 1999).

Nonetheless, it typically show a technology utilized exactly as envisioned (Nathan et al., 2007).
Instead of considering the General effects of widespread usage of technology, practitioners often simply take into account the proximate partners and settings applied. Design imaginations is innovative curiosity, expressing concerns, and inquiry, according to an expanding collection of research in HCI. (Bleecker, 2009).

Design imaginations provide an unsubstantiated setting for exploring issues such as if a given innovation is beneficial, the cultural presumptions embedded, the possibility for various systems to generate unique products, our relationship to technological advances, and even our shaping the tomorrow.

Between hypothetical and analytical imaginations, design imaginations can be found. Speculative imagination is adventurous. Analytical imaginations, that are more severe, are steeped in crucial practices and pose basic queries about the Structure of humanity (Dunne and Ruby, 2001). By default, they contest scientific solutions, which refers to the way technologies appear to be developed to either disregard potential context-related problems or fix problems that may not even arise (Blythe et al., 2016).

There are several approaches that design imaginations can be applied to investigation, including: 1.

Imaginations are the product itself.

2. In participant observation or surveys, imaginations (or an artifact) serve to generate study data. Lyckvi (2018).

3. Being a vital component of growing recognition, majority's imaginations are jointly produced (e.g. Tsekleves et al. 2017).

Design imaginations are especially effective techniques for researching the prospective effects of AI and robots on HE. Several academics including Selwyn et al., Luckin and Holmes, and Pinkwart (2016) have employed those (2020). Design imaginations distills important concerns into a concise, approachable format for use as study aid. It potentially do have power to alter the discussion's perspective by shifting the focus from contemporary literature's emphasis on creating and evaluating particular AI applications to societal trends are more or less acceptable,(Zawacki-Richter et al., 2019). They are useful important matters that programmers are not really considering due to WEIRD bias in the scientific community to refocus attention on morality and egalitarianism concerns, and to cast suspicion on its viability given actual barriers to adoption,(Blanchard, 2015). The imaginative and empathetic aspects of imaginations attract learners. Additionally, it is clearly works of imagination, people are free to question them and even rewrite things.

Individualized writings are typical of design imaginations. The option for assessing imaginative collections compared to one another, however, encourages speculation about alternative possibilities. Akin to this, future work frequently develop models that involve four options, each predicated on a separate hypothesis (Inayatullah, 2008). This prevents the temptation toward an idealistic split present in such imaginal works (Rummel et al., 2016; Pinkwart 2016). Consequently, the aim of this research is to develop a set of conflicting imaginations that bring to fore the various arguments surrounding the use of AI and robotics to H E.

The procedure for generating fantasies is difficult to make explicit.

A thorough descriptive empirical underpinned the work's framework for imaginations (Templier and Paré, 2015). The goal is to offer an understanding of the pedagogical, cultural, altruistic, and execution concerns discussed by the most recent developments in the use of AI and robots for teaching, scientific studies, and administrative activities in HE, as a basis for stories that can represent the issues in an imagined way. Past case reports have shown that the research on AIEDS neglects such sorts of concerns (Zawacki-Richter et al., 2019). The study's key novelty therefore rest in (a) emphasizing cultural, altruistic, pedagogical, and management consequences (b) AI and robotics as relevant components of automated processes, and (c) attempting to be encompassing throughout full spectrum of HE tasks, including effects on learning and academic communication channels, in addition to administrative activities and property holdings.***

To find relevant terms like "AI or Artificial Intelligence,""communicative device," and "AIED," the ERIC directory was carefully searched. Materials that merely addressed general issues or those that appeared in in-depth reviews so that readers could get a sense of the most recent developments were selected. This extensive search was combined with steamrolling to find additional relevant material, using citations from directly important results. Reviewers occasionally ignore this, but

Appropriate terms like "AI or Artificial Intelligence," "communicative device," and "AIED," the ERIC database proved carefully searched. Publications merelyMaterials that merely addressed general issues or those that appeared in in-depth reviews so that readers could get a sense of the most recent developments were selected. This extensive search was combined with pushing to find additional relevant material, using citations from directly important findings. Reviewers occasionally ignore this, butDiscovering extremely relevant information using this method has been proven to be very successful. (Badampudi et al. 2015). Numerous public writings

that summarize the effects of AI and robots led to the incorporation of some dark contents. Despite not being directly related to learning, some writings on AI and robots were also considered to be important, particularly in light of the possibility that learning may be a latecomer and that effects would be felt more through wider societal modifications than by e-learning. Reviews of research that revealed trends with modern buildings were inclusive; however, papers that offered in-depth analyses of how technologies evolved were not. More than 200 of the 500 articles examined were deemed to be extremely pertinent. As a result, this study was not "comprehensive" and is instead seen as an addition to previous research that had different goals. The investigation was successful in locating a number of literary imaginations that could be more effectively reduced or expanded upon to better satisfy the investigations of those that apply to higher education.

As an imaginative act, writing imaginationis not reducible to a completely transparent method, although some aspects can be described (Lyckvi et al., 2018). Some techniques to create effective critical designs are suggested by Auger (2013) such as placing something uncanny or unexpected against the backdrop of mundane normality and a sense of verisimilitude (perhaps achieved through mixing fact andimagination). Imagination6, for example, exploits the mundane feel of committee meeting minutes to help us imagine the debates that would occur among university leaders implementing AI. A common strategy is to take the implications of a central counterfactual premise to its logical conclusion: asking: "what if?" For example, imagination 7 extends existing strategies of gathering data and using Automated Conversational System to act on them to its logical extension as a comprehensive system of data surveillance.

Table 1 offers a summary of the eight imagination produced through this process. The imagination explore the potential of AI and robots in different areas of university activity, in learning, administration and research (Table 1 column 5). They seek to represent some different types of technology (column 2). Some are rather futuristic, most seem feasible today, or in the very near future (column 3). The full text of the imaginationand supporting material can be downloaded from the University of Sheffield data repository, ORDA, and used under a cc-by-aslicense (https://doi.org/10.35542/osf.io/s2jc8). The following sections describe each imagination in turn, showing how it relates to the literature and surfaces relevant issues.

Table 2 below will view the issues raised.

Table 1 Summary of the design imaginationTable 1 Summary of the design imaginationFrom: Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design imagination

	Technologies involved	Time frame	Genre	Area of application to HE
imagination 1: AIDan, the teaching assistant	Intelligent tutoring systems, adaptive pedagogical agents, use of sensors to allow affective/embodied adaptively	Future	Traditional design scenario	Teaching
imagination 2: Footbotball	Robots	Future	Soliloquy	Extra curricula activity
imagination 3: CriticalBot in conversation	Conversational agent	Present	Dialogue	Teaching
imagination 4: The intelligent campus app	Smart campus: way finding, nudging	Present/near future	Mundane, day in the life	Estates management/ Teaching
imagination 5: Research Management Suite TM	Text and Data Mining, auto summarization, auto writing	Future	Marketing and PR material	Research
imagination 6: Verbatim minutes of University AI project	Not defined	Near future	Meeting minutes	All

	Technologies involved	Time frame	Genre	Area of application to HE
steering committee: AI implementation phase 3				
imaginationards	Data mining, conversational agents	Future	Soliloquy	Administration/Teaching
imagination 8: Minnie, the AI admin assistant	Conversational agents	Near future	Surreal, cyberpunk dystopia	Administration, Wider social infrastructure

Table 2 Issues raised in the imagination

Table 2 Issues raised in the imaginationFrom: Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design imagination

Issue	imagination 1	imagination2	imagination 3	imagination 4	Imagination 5	imagination6	imagination 7	imagination 8
Nature of the interface between humans and AI/ robots	X	X	X	X			X	X
Affective aspects of relations with AI and robots	X	X	x	X				X
Gaming of AI by users			X				x	
Role of AI/robots in teaching high order skills, such as influencing or criticality	X	X	X	X		x		
Commercial drivers for AI					X	X	x	X
Digitalization	x	x			X	X	X	x
Infrastructure required to sustain AI								X
Impact on employment / staff skills required	X	X	X		X	X		X

In the following sections each of the eight imagination is described, set in the context of the literature review material that shaped their construction.

AI and robots in learning: imagination1, "AIDan, the teaching assistant"

Much of the literature around AI in learning focuses on tools that directly teach students (Baker and Smith, 2019; Holmes et al., 2019; Zawacki-Richter et al., 2019). This includes classes of systems such as:

Intelligent tutoring systems (ITS) which teach course content step by step, taking an approach personalized to the individual. Holmes et al. (2019) differentiate different types of Intelligent Tutoring Systems, based on whether they adopt a linear, dialogic or more exploratory model.

One emerging area of adaptively using sensors to detect the emotional and physical state of the learner, recognizing the embodied and affective aspects of learning (Luckin, et al., 2016); a further link is being made to how virtual and augmented reality can be used to make the experience more engaging and authentic (Holmes et al., 2019).

Automatic writing evaluation (AWE) which are tools to assess and offer feedback on writing style (rather than content) such as learn-and-write, Grammarly and Turnitin's Revision Assistant (Strobl, et al. 2019; Hussein et al., 2019; Hockly, 2019).

Conversational agents (also known as Chatbots or virtual assistants) which are AI tools designed to converse with humans (Winkler and Söllner, 2018).

The adaptive pedagogical agent, which is an "anthropomorphic virtual character used in an online learning environment to serve instructional purposes" (Martha and Santosh, 2017).

Many of these technologies are rather mature, such as AWE and ITS. However, there are also a wide range of different type of systems within each category, e.g. conversational agents can be designed for short or long term interaction, and could act as tutors, engage in language practice, answer questions, promote reflection or act as co-learners. They could be based on text or verbal interaction (Følstad et al., 2019; Wellnhammer et al., 2020).

Much of such literature reflects the development of AI technologies and their evaluation compared to other forms of teaching. However, according to a recent review it is primarily written by computer scientists mostly from a technical point of view with relatively little connection to pedagogy or ethics (Zawacki-Richter et al., 2019). In contrast some authors such as Luckin and Holmes, seek to move beyond the rather narrow development of tools and their evaluation, to envisioning how AI can address the grand challenges of learning in the twenty-first century (Luckin, et al. 2016; Holmes et al., 2019; Woolf et al., 2013). According to this vision many of the inefficiencies and injustices of the current global education system can be addressed by applying AI.

The emphasis is given to:

1.AI designed to support teachers rather than replacing them;

2.Personalisation of learning experiences through adaptively;

3.Replacement of one-off assessment by continuous monitoring of performance (Luckin, 2017);

4.The monitoring of haptic data to adjust learning material to students' emotional and physical state in real time;

5.The potential of AI to support learning twenty-first century skills, such as collaborative skills;

6.Teachers developing skills in data analysis as part of their role;

7.Students (and parents) as well as teachers having access to data about their learning.

While Luckin and Holmes (2017) acknowledge that the vision of AI sounds a "bit big brother" it is, as one would expect, essentially an optimistic piece in which all the key technologies they envisage are brought together to improve learning in a broad sense. The imagination developed here retains most of these elements, but reimagined for an HE context, and with a number of other changes:

1.Reference is also made to rooting teaching in learning science, one of the arguments for AI Luckin makes in a number of places (e.g. Luckin et al. 2016).

2.Students developing a long term relationship with the AI. It is often seen as a desirable aspect of providing AI as a lifelong learning partner (Woolf, et al. 2013).

Of course, the more skeptical reader may be troubled by some aspects of this vision, including the potential effects of continuously monitoring performance as a form of surveillance. The emphasis on personalization of learning through AI has been increasingly questioned (Selwyn, 2019a).

The following excerpt gives a flavor of the imagination:

Actually, I partly picked this Uni because I knew they had AI like AIDan which teach you on principles based in learning science.

And exams are a thing of the past! AIDan continuously updates my profile and uses this to measure what I have learned.

I have set tutorials with AIDan to analyze data on my performance. Jane often talks me through my learning data as well.

I work with him planning things like my module choices too.

Some of my data goes to people in the department (like my personal tutor) to student and campus services and the library to help personalize their services.

Social robots in learning: imagination2, "Football"

The protagonist describes how he is benefiting from using university facilities to participate in an imaginary sport, football.

Maybe it's a bit weird to say, but it's about developing mutual understanding and… respect. Like the bots can sense your feelings too and chip in with a word just to pick you up if you make a mistake. And you have to develop an awareness of their needs too. Know when is the right time to say something to them to influence them in the right direction. When you watch the best teams they are always like talking to each other. But also just moving together, keeping eyes on and moving as a unit.

The protagonist in imagination 2 describes the high level and employability skills he is learning from a sporting application of robotics. This also reminds us of how the widespread use of AI and robots in wider social contexts may be a key driver for adoption in HE.

Imagination 3: "Criticalbot in conversation"

Both imagination1 and 2 are glossy science imagination, with a strongly futuristic feel and, as in traditional design scenarios the technology seems to be used as intended by the designer. In contrast, the third imagination is inspired by Bayne's (2015) description of Teacherbot, a chatbot developed to support a MOOC on eLearning and digital cultures. Teacherbot does not masquerade as human. Students on the course are told what it is and its interactions are clumsy enough to reveal this anyway. Yet Bayne's (2015) argument is that it offers positive non-human affordances. Students seem to learn from it, partly by reflecting on its place in their learning. Thus imagination3, echoing the sample transcripts between Teacherbot and real students quoted in Bayne (2015), is a fimaginational dialogue between a conversational agent and a group of students working on an assignment (itself on the topic of bias in AI

Student 1: @CriticalBot we have been set the task to research bias in AIED. What do you know about bias in AIED?

CriticalBot: Blanchard is recommended in the reading list.

Student 2: I think he means trim.

Student 1: Blanchard?

CriticalBot: Sorry. I should have typed: Blanchard, E. G. (2015). Socio-cultural imbalances in AIED research: Investigations, implications and opportunities. International Journal of Artificial Intelligence in Education, 25(2), 204–228. No one's perfect.

Student 1: @CriticalBot What is the main point he makes?

CriticalBot: Nice try. Try reading the abstract. Abstracts summaries key points. It may also be useful to read the conclusion section to grasp the author's main argument before deciding on whether to undertake a closer reading.

As the quotation from the imagination illustrates, echoing Bayne (2015), the conversation in imagination2 is not necessarily smooth; misunderstandings and conflicts occur. The imaginationbrings into view the less compliant vision of the student who might wish to game the system, a potential problem with AI which is apparent in the literature of AWE (Hussein et al. 2019). This imaginationencapsulates an important alternative potential imaginary of AI, as a simple, low-tech intervention. At the same time in being designed to promote critical thinking it can also be seen as teaching a key, high-level skill. This challenges us to ask if an AI can truly do that and how.

The intelligent campus: imagination 4, "The intelligent campus app"

The AIED literature with its emphasis on the direct application of AI to learning accounts for a big block of the literature about AI in Higher Education, but not all of it. Another rather separate literature exists around the smart or intelligent campus (e.g. JISC 2018; Min-Allah and Alrashed, 2020; Dong et al., 2020). This is the application of Internet of Things and increasingly AI to the

management of the campus environment. This is often oriented towards estates management, such as monitoring room usage and controlling lighting and heating. But it does also encompass support of way finding, attendance monitoring, and ultimately of student experience, so presents an interesting contrast to the AIED literature.

The fourth imaginationis adapted from a report each section of which is introduced by quotes from an imaginary day in the life of a student, Leda, who reflects on the benefits of the intelligent/smart campus technologies to her learning experience (JISC, 2018). The emphasis in the report is on:

1.Data driven support of way finding and time management;

2.Integration of smart campus with smart city features (e.g. bus and traffic news);

There is quite a big slot this morning when the App suggests I could be in the library planning the essay – as well as doing the prep work for one of the classes it has reminded me about.

It is predicting that the library is going to be very busy after 11AM anyway, so I decide to go straight there.

The imagination seeks to bring out more about the idea of "nudging" to change behaviours a concept often linked to AI and the ethics of which are queried by Selwyn (2019a). The issue of how AI and robots might impact the agency of the learner recurs across the imaginations.

AI and robotics in research: imagination5, "The Research Management Suite TM"

So far in this paper most of the focus has been on the application of AI and robotics to learning. AI also has applications in university research, but it is an area far less commonly considered than learning and teaching. Some AI could be used directly in research, not just to perform analytical tasks, but to generate hypotheses to be tested (Jones et al., 2019). The "robot scientist" being tireless and able to work in a precise way could carry through many experiments and increase reproducibility (King, et al., 2009; Sparkes et al., 2010). It might have the potential to make significant discoveries independently, perhaps by simply exploiting its tirelessness to test every possible hypothesis rather than use intuition to select promising ones (Kitano, 2010). This does not suggest the end of the academic author, Springer suggest, but does imply changing roles (Schoenenberger, 2019). AI is being applied to many aspects of the publication process: to identify peer reviewers (Price and Flach, 2017), to assist review by checking statistics, to summarize open peer reviews, to check for plagiarism or for the fabrication of data (Heaven, 2018), to assist copy editing, to suggest keywords and to summaries and translate text. Other tools claim to predict the future citation of articles (Thelwall, 2019). Data about academics, their patterns of collaboration and citation through scientometrics are currently based primarily on structured bibliographic data. The cutting edge is the application of text mining techniques to further analyze research methods, collaboration patterns, and so forth (Atanassova et al., 2019). This implies a potential revolution in the management and evaluation of research. It will be relevant to ask what responsible research metrics are in this context (Wilsdon, 2015).

Instantiating these developments, the sixth imagination revolves around a university licensing "Research Management Suite TM "a set of imaginary proprietary tools to offer institutional level support to its researchers to increase and perhaps measure their productivity. A flavour of the imagination Academic Mentor ™ is our premium meta-analysis service. Drawing on historic career data from across the disciplines, it identifies potential career pathways to inform your choices in your research strategy. By identifying structural holes in research fields it enables you to position your own research within emerging research activity, so maximizing your visibility and contribution. Mining data from funder strategy, the latest publications, preprints and news sources it identifies emergent interdisciplinary fields, matching your research skills and interests to the complex dynamics of the changing research landscape.

This imagination prompts questions about the nature of the researcher's role and ultimately about what research is. At what point does the AI become a co-author, because it is making a substantive intellectual contribution to writing a research output, making a creative leap or even securing funding? Given the centrality of research to academic identity this indeed may feel even more challenging than the teaching related scenarios. This also recognized the important role of EdTech companies in how AI reaches HE, partly because of the high cost of AI development.

A very large literature around technologies in HE in general focuses on the challenges of implementing them as a change management problem. Reid (2021), for example, seeks to develop a model of the differing factors that block the smooth implementation of learning technologies in the classroom, such as problems with access to the technology, project management challenges, as well as issues around teacher identity. Echoing these arguments, Tsai et al.'s (2021, 2020) work captures why for all the hype around it, Learning Analytics have not yet found extensive practical application in HE. Given that AI requires intensive use of data, by extension we can argue that the same barriers will probably apply to AI. Specifically Tsai et al. (2020, 2021) identify barriers in terms of technical, financial and other resource demands, ethics and privacy issues, failures of leadership, a failure to

involve all stakeholders (students in particular) in development, a focus on technical issues and neglect of pedagogy, insufficient staff training and a lack of evidence demonstrating the impact on learning. Reflecting these thoughts, the fifth imagination is an extract from an imaginary committee meeting, in which senior university managers discuss the challenges they are facing in implementing AI. It seeks to surface issues around teacher identity, disciplinary differences and resource pressures that might shape the extensive implementation of AI in practice.

Faculty of Humanities Director: But I think there is a pedagogic issue here. With the greatest of respect to Engineering, this approach to teaching, simply does not fit our subject. You cannot debate a poem or a philosophical treatise with a machine.

Faculty of Engineering Director: The pilot project also showed improved student satisfaction. Data also showed better student performance. Less drop outs.

Faculty of Humanities Director: Maybe that's because…

Vice Chancellor: All areas where Faculty of Humanities has historically had a strategic issue.

Faculty of Engineering Director: The impact on employability has also been fantastic, in terms of employers starting to recognize the value of our degrees now fluency with automation is part of our graduate attributes statement.

Faculty of Humanities Director: I see the benefits, I really do. But you have to remember you are taking on deep seated assumptions within the disciplinary culture of Humanities at this university. Staff are already under pressure with student numbers not to mention in terms of producing world class research! I am not sure how far this can be pushed. I wouldn't want to see more industrial action.

Learning analytics and digitalization: imagination 7, "Dashboards"

Given the strong relation between "big data" and AI, the claimed benefits and the controversies that already exist around LA are relevant to AI too (Selwyn, 2019a). The main argument for LA is that they give teachers and learners themselves information to improve learning processes. Advocates talk of an obligation to act. LA can also be used for the administration of admissions decisions and ensuring retention. Chatbots are now being used to assist applicants through complex admissions processes or to maintain contact to ensure retention and appear to offer a cheap and effective alternative (Page and Gehlbach, 2017; Nurshatayeva et al., 2020).

Another inevitable concern is with legality and the need to abide by appropriate privacy legislation, such as GDPR in Europe. Linked to this are clearly privacy issues, implying consent, the right to control over the use of one's data and the right to withdraw (Field et al., 2020). Yet a recent study by Jones (2020) found students knew little of how LA were being used in their institution or remembered consenting to allowing their data to be used. These would all be recognized as issues by most AI projects.

However, increasingly critiques of AI in learning centre around the digitalization of education (Jarke and Breiter, 2019; Williamson and Eynon, 2020; Selwyn, 2019a; Kwet and Prinsloo, 2020). A data driven educational system has the potential to be used or experienced as a surveillance system. "What can be accomplished with data is usually a euphemism for what can be accomplished with surveillance" (Kwet and Prinsloo, 2020: 512). Not only might individual freedoms be threatened by institutions or commercial providers undertaking surveillance of student and teaching staff behaviour, there is also a chilling effect just through the fear of being watched (Kwet and Prinsloo, 2020). Students become mere data points, as surveillance becomes intensified and normalized (Manolev et al. 2019). While access to their own learning data could be empowering for students, techniques such as nudging intended to influence people without their knowledge undermine human agency (Selwyn, 2019b). Loss of human agency is one of the fears revolving around AI and robots.

Further, a key issue with AI is that although predictions can be accurate or useful it is quite unclear how these were produced. Because AI "learns" from data, even the designers do not fully understand how the results were arrived at so they are certainly hard to explain to the public. The result is a lack of transparency.

Much of the current debate around big data and AI revolves around bias, created by using training data that does not represent the whole population, reinforced by the lack of diversity among designers of the systems. If data is based on existing behaviour, this is likely to reproduce existing patterns of disadvantage in society, unless AI design takes into account social context—but digitalization is driven by standardization. Focusing on technology diverts attention from the real causes of achievement gaps in social structures, it could be argued (Macgilchrist, 2019). While often promoted as a means of empowering learners and their teachers, mass personalisation of education redistributes power away from local decision making (Jarke and Breiter, 2019; Zeide, 2017). Digitalization also produces performativity: the tendency of institutions (and teachers and students) to shift their behaviour towards doing what scores well against the metric, in a league table mentality. Yet what is measured is often a proxy of learning or reductive of what learning in its full sense is, critics argue (Selwyn, 2019b). The potential impact is to turn HE further into a marketplace (Williamson, 2019). It is evident that AI developments are often partly a marketing exercise (Lacity, 2017). Edtech companies play

a dominant role in developing AI (Williamson and Eynon, 2020). Selwyn (2019a) worries that those running education will be seduced by glittering promises of techno-isolationism, when the technology does not really work. The UK government has invested heavily in gathering more data about HE in order to promote the reform of HE in the direction of marketization and student choice (Williamson and Eynon, 2020). Learning data could also increasingly itself become a commodity, further reinforcing the commercialization of HE.

We can dip down into attendance, learning environment use, library use, and of course module level performance and satisfaction plus the extra-curricular data. Really low-level stuff some of it. It's pretty much all there, monitored in real time. We are really hot on transition detection and monitoring. The chatbots are used just to check in on students, see they are ok, nudge things along, and gather more data. Sometimes you just stop and look at it ticking away and think "wow!" That all gets crunched by the system. All the time we feed the predictive down into departmental dashboards, where they pick up the intervention work. Individual teaching staff has access via smart speaker. Meanwhile, we monitor the trend lines up here.

In the imagination the benefits in terms of being able to monitor and address attainment gaps is emphasized. The protagonist's description of projects that are being worked on suggests competing drivers behind such developments including meeting government targets, cost saving and the potential to make money by reselling educational data.

Infrastructure: imagination8, "Minnie—the AI admin assistant"

A further dimension to the controversy around AI is to consider its environmental cost and the societal impact of the wider infrastructures needed to support AI. Brevini (2020) points out that a common AI training model in linguistics can create the equivalent of five times the lifetime emissions of an average US car. This foregrounds the often unremarked environmental impact of big data and AI. It also prompts us to ask questions about the infrastructure required for AI. Crawford and Joler's (2018) brilliant Anatomy of an AI system reveals that making possible the functioning of a physically rather unassuming AI like Amazon echo, is a vast global infrastructure based on mass human labour, complex logistic chains and polluting industry.

The first part of imagination 8 describes a personal assistant based on voice recognition, like Siri, which answers all sorts of administrative questions. The protagonist expresses some unease with how the system works, reflecting the points made by Rummel et al. (2016) about the failure of systems if despite their potential sophistication they lack nuance and flexibility in their application. There is also a sense of alienation (Griffiths, 2015). The second part of the imaginationextends this sense of unease to a wider perspective on the usually invisible, but very material infrastructure which AI requires, as captured in Crawford and Joler (2018). In addition, imagery is drawn from Maughan's (2016) work where he travels backwards up the supply chain for consumer electronics from the surreal landscape of hi-tech docks then visiting different types of factories and ending up visiting a huge polluted lake created by mining operations for rare earth elements in China. This perspective queries all the other imaginationmass the global infrastructures that are required to make AI possible. The vast effort of global logistics to bring together countless components to build the devices through which we interact with AI. Lorries queuing at the container port as another ship comes in to dock.

Conclusion

As we have seen each of the imaginationseeks to open up different positive visions or dimensions of debate around AI (summarized in Table 2 below). All implicitly ask questions about the nature of human agency in relationship to AI systems and robots, be that through empowerment through access to learning data (imagination1), their power to play against the system (imagination3) or the hidden effects of nudging (imagination 4) and the reinforcements of social inequalities. Many raise questions about the changing role of staff or the skills required to operate in this environment. They are written in a way seeking to avoid taking sides, e.g. not to always undercut a utopian view or simply present a dark dystopia. Each contains elements that might be inspirational or a cause of controversy. Specifically, they can be read together to suggest tensions between different possible futures. In particular imagination7 and 8 and the commercial aspects implied by the presentation of imagination 5, reveal aspects of AI largely invisible in the glossy strongly positive images in imagination 1 and 2, or the deceptive mendacity of imagination 3. It is also anticipated that the imagination will be read "against the grain" by readers wishing to question what the future is likely to be or should be like. On the basis of the understanding gained from the literature review a secondary contribution was the development of a collection of eight accessible, repurpose able design imagination that prompt debate about the potential role of AI and robots in HE. This prompts us to notice common challenges, such as around commodification and the changing role of data. It encompasses work written by developers, by those with more visionary views, those who see the challenges as primarily pragmatic and those coming from much more critical perspectives.

The imagination are intended to be used to explore staff and student responses through data collection using the imagination to elicit views. The imagination could also be used in teaching to prompt debate among students, perhaps setting them the task to write new imagination (Rapp, 2020). Students of education could use them to explore the potential impact of AI on educational institutions and to discuss the role of technologies in educational change more generally. The imagination could be used in teaching students of

computer science, data science, HCI and information systems in courses about computer ethics, social responsibility and sustainable computing—as well as those directly dealing with AI. They could also be used in Media Studies and Communications, e.g. to compare them with other future imaginaries in science imagination or to design multimedia creations inspired by such imagination they might also

be used for management studies as a case study of strategizing around AI in a particular industry.

While there is an advantage in seeking to encompass the issues within a small collection of engaging imagination that in total run to less than 5000 words, it must be acknowledged that not every issue is reflected. For example, what is not included is the different ways that AI and robots might be used in teaching different disciplines, such as languages, computer science or history. The many ways that robots might be used in background functions or to play the role themselves of learner also requires further exploration. Most of the imaginationwere located in a fairly near future, but there is also potential to develop much more futuristic imagination these gaps leave room for the development of more imagination.

References

Amer, M., Daim, T., &Jetter, A. (2013). A review of scenario planning. Futures, 46, 23–40.

Article Google Scholar

Atanassova, I., Bertin, M., &Mayr, P. (2019). Editorial: mining scientific papers: NLP-enhanced bibliometrics. Frontiers in Research Metrics and Analytics. https://doi.org/10.3389/frma.2019.00002.

Article Google Scholar

Auger, J. (2013). Speculative design: Crafting the speculation. Digital Creativity, 24(1), 11–35.

Article Google Scholar

Badampudi, D., Wohlin, C., & Petersen, K. (2015). Experiences from using snowballing and database searches in systematic literature studies. In Proceedings of the 19th International Conference on Evaluation and Assessment in Software Engineering (pp. 1–10).

Baker, T., Smith, L. and Anissa, N. (2019). Educ-AI-tion Rebooted? Exploring the future of artificial intelligence in schools and colleges. NESTA. https://www.nesta.org.uk/report/education-rebooted/.

Bates, T., Cobo, C., Mariño, O., & Wheeler, S. (2020). Can artificial intelligence transform higher education? International Journal of Educational Technology in Higher Education. https://doi.org/10.1186/s41239-020-00218-x.

Article Google Scholar

Bayne, S. (2015). Teacherbot: interventions in automated teaching. Teaching in Higher Education, 20(4), 455–467.

Article Google Scholar

Belpaeme, T., Kennedy, J., Ramachandran, A., Scassellati, B., & Tanaka, F. (2018). Social robots for education: A review. https://doi.org/10.1126/scirobotics.aat5954.

Article Google Scholar

Blanchard, E. G. (2015). Socio-cultural imbalances in AIED research: Investigations, implications and opportunities. International Journal of Artificial Intelligence in Education, 25(2), 204–228.

Article Google Scholar

Bleecker, J. (2009). Design imagination A short essay on design, science, fact and imagination Near Future Lab.

Blythe, M. (2017). Research imagination: storytelling, plot and design. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (pp. 5400–5411).

Blythe, M., Andersen, K., Clarke, R., & Wright, P. (2016). Anti-solutions strategies: Seriously silly design imagination. Conference on Human Factors in Computing Systems - Proceedings (pp. 4968–4978). Association for Computing Machinery.

Brevini, B. (2020). Black boxes, not green: Mythologizing artificial intelligence and omitting the environment. Big Data & Society, 7(2), 2053951720935141.

Article Google Scholar

Canzonetta, J., & Kannan, V. (2016). Globalizing plagiarism & writing assessment: a case study of Turnitin. The Journal of Writing Assessment, 9(2). http://journalofwritingassessment.org/article.php?article=104.

Carroll, J. M. (1999) five reasons for scenario-based design. In Proceedings of the 32nd Annual Hawaii International Conference on Systems Sciences. HICSS-32. Abstracts and CD-ROM of Full Papers, Maui, HI, USA, 1999, pp. 11. https://doi.org/10.1109/HICSS.1999.772890.

Catlin, D., Kandlhofer, M., &Holmquist, S. (2018). EduRobot Taxonomy a provisional schema for classifying educational robots. 9th International Conference on Robotics in Education 2018, Qwara, Malta.

Clay, J. (2018). The challenge of the intelligent library. Keynote at What does your eResources data really tell you? 27th February, CILIP.

Crawford, K., &Joler, V. (2018) Anatomy of an AI system, https://anatomyof.ai/.

Darby, E., Whicher, A., &Swiatek, A. (2017). Co-designing design imagination a new approach for debating and priming future healthcare technologies and services. Archives of design research. Health Services Research, 30(2), 2.

Google Scholar

Demartini, C., &Benussi, L. (2017). Do Web 4.0 and Industry 4.0 Imply Education X.0? IT Pro, 4–7.

Dong, Z. Y., Zhang, Y., Yip, C., Swift, S., &Beswick, K. (2020). Smart campus: Definition, framework, technologies, and services. IET Smart Cities, 2(1), 43–54.

Article Google Scholar

Dourish, P., & Bell, G. (2014). "Resistance is futile": Reading science imagination alongside ubiquitous computing. Personal and Ubiquitous Computing, 18(4), 769–778.

Article Google Scholar

Dunne, A., &Raby, F. (2001). Design noir: The secret life of electronic objects. New York: Springer Science & Business Media.

Google Scholar

Fjeld, J., Achten, N., Hilligoss, H., Nagy, A., &Srikumar, M. (2020). Principled artificial intelligence: Mapping consensus in ethical and rights-based approaches to principles for AI. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3518482.

Article Google Scholar

Følstad, A., Skjuve, M., &Brandtzaeg, P. (2019). Different chatbots for different purposes: Towards a typology of chatbots to understand interaction design. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). 11551 LNCS, pp. 145–156. Springer Verlag.

Future TDM. (2016). Baseline report of policies and barriers of TDM in Europe. https://project.futuretdm.eu/wp-content/uploads/2017/05/FutureTDM_D3.3-Baseline-Report-of-Policies-and-Barriers-of-TDM-in-Europe.pdf.

Gabriel, A. (2019). Artificial intelligence in scholarly communications: An Elsevier case study. Information Services & Use, 39(4), 319–333.

Article Google Scholar

Griffiths, D. (2015). Visions of the future, horizon report. LACE project. http://www.laceproject.eu/visions-of-the-future-of-learning-analytics/.

Heaven, D. (2018). The age of AI peer reviews. Nature, 563, 609–610.

Article Google Scholar

Hockly, N. (2019). Automated writing evaluation. ELT Journal, 73(1), 82–88.

Article Google Scholar

Holmes, W., Bialik, M. and Fadel, C. (2019). Artificial Intelligence in Education. The center for curriculum redesign. Boston, MA.

Hussein, M., Hassan, H., &Nassef, M. (2019). Automated language essay scoring systems: A literature review. PeerJ Computer Science. https://doi.org/10.7717/peerj-cs.208.

Article Google Scholar

Inayatullah, S. (2008). Six pillars: Futures thinking for transforming. foresight, 10(1), 4–21.

Jarke, J., &Breiter, A. (2019). Editorial: the digitalization of education. Learning, Media and Technology, 44(1), 1–6.

Article Google Scholar

JISC. (2019). The intelligent campus guide. Using data to make smarter use of your university or college estate. https://www.jisc.ac.uk/rd/projects/intelligent-campus.

Jones, E., Kalantery, N., & Glover, B. (2019). Research 4.0 Interim Report. Demos.

Jones, K. (2019). "Just because you can doesn't mean you should": Practitioner perceptions of learning analytics ethics. Portal, 19(3), 407–428.

Article Google Scholar

Jones, K., Asher, A., Goben, A., Perry, M., Salo, D., Briney, K., &Robertshaw, M. (2020). "We're being tracked at all times": Student perspectives of their privacy in relation to learning analytics in higher education. Journal of the Association for Information Science and Technology. https://doi.org/10.1002/asi.24358.

Article Google Scholar

King, R. D., Rowland, J., Oliver, S. G., Young, M., Aubrey, W., Byrne, E., et al. (2009). The automation of science. Science, 324(5923), 85–89.

Article Google Scholar

Kitano, H. (2016). Artificial intelligence to win the Nobel Prize and beyond: Creating the engine for scientific discovery. AI Magazine, 37(1), 39–49.

Article Google Scholar

Kwet, M., &Prinsloo, P. (2020). The 'smart' classroom: a new frontier in the age of the smart university. Teaching in Higher Education, 25(4), 510–526.

Article Google Scholar

Lacity, M., Scheepers, R., Willcocks, L. & Craig, A. (2017). Reimagining the University at Deakin: An IBM Watson Automation Journey. The Outsourcing Unit Working Research Paper Series.

Lowendahl, J.-M., & Williams, K. (2018). 5 Best Practices for Artificial Intelligence in Higher Education. Gartner. Research note.

Luckin, R. (2017). Towards artificial intelligence-based assessment systems. Nature Human Behaviour, 1(3), 1–3.

Article Google Scholar

Luckin, R., & Holmes, W. (2017). A.I. is the new T.A. in the classroom. https://howwegettonext.com/a-i-is-the-new-t-a-in-the-classroom-dedbe5b99e9e.

Luckin, R., Holmes, W., Griffiths, M., & Pearson, L. (2016). Intelligence unleashed an argument for AI in Education. Pearson. https://www.pearson.com/content/dam/one-dot-com/one-dot-com/global/Files/about-pearson/innovation/open-ideas/Intelligence-Unleashed-v15-Web.pdf.

Lyckvi, S., Wu, Y., Huusko, M., &Roto, V. (2018). Eagons, exoskeletons and ecologies: On expressing and embodying imaginationas workshop tasks. ACM International Conference Proceeding Series (pp. 754–770). Association for Computing Machinery.

Macgilchrist, F. (2019). Cruel optimism in edtech: When the digital data practices of educational technology providers inadvertently hinder educational equity. Learning, Media and Technology, 44(1), 77–86.

Article Google Scholar

Manolev, J., Sullivan, A., &Slee, R. (2019). The digitalization of discipline: ClassDojo, surveillance and a per formative classroom culture. Learning, Media and Technology, 44(1), 36–51.

Article Google Scholar

Martha, A. S. D., & Santos, H. B. (2019). The design and impact of the pedagogical agent: A systematic literature review. Journal of Educators Online, 16(1), n1.

Article Google Scholar

Maughan, T. (2016). The hidden network that keeps the world running. https://datasociety.net/library/the-hidden-network-that-keeps-the-world-running/.

McDonald, D., & Kelly, U. (2012). The value and benefits of text mining. England: HEFCE.

Google Scholar

Min-Allah, N., &Alrashed, S. (2020). Smart campus—A sketch. Sustainable Cities and Society. https://doi.org/10.1016/j.scs.2020.102231.

Article Google Scholar

Nathan, L. P., Klasnja, P. V., & Friedman, B. (2007). Value scenarios: a technique for envisioning systemic effects of new technologies. In CHI'07 extended abstracts on human factors in computing systems (pp. 2585–2590).

Nurshatayeva, A., Page, L. C., White, C. C., &Gehlbach, H. (2020). Proactive student support using artificially intelligent conversational chatbots: The importance of targeting the technology. EdWorking paper, Annenberg University https://www.edworkingpapers.com/sites/default/files/ai20-208.pdf.

Page, L., &Gehlbach, H. (2017). How an artificially intelligent virtual assistant helps students navigate the road to college. AERA Open. https://doi.org/10.1177/2332858417749220.

Article Google Scholar

Pinkwart, N. (2016). Another 25 years of AIED? Challenges and opportunities for intelligent educational technologies of the future. International journal of artificial intelligence in education, 26(2), 771–783.

Article Google Scholar

Price, S., &Flach, P. (2017). Computational support for academic peer review: A perspective from artificial intelligence. Communications of the ACM, 60(3), 70–79.

Article Google Scholar

Rapp, A. (2020). Design imagination for learning: A method for supporting students in reflecting on technology in human–computer interaction courses. Computers & Education, 145, 103725.

Article Google Scholar

Reid, P. (2014). Categories for barriers to adoption of instructional technologies. Education and Information Technologies, 19(2), 383–407.

Article Google Scholar

Renz, A., &Hilbig, R. (2020). Prerequisites for artificial intelligence in further education: Identification of drivers, barriers, and business models of educational technology companies. International Journal of Educational Technology in Higher Education. https://doi.org/10.1186/s41239-020-00193-3.

Article Google Scholar

Roll, I., & Wylie, R. (2016). Evolution and Revolution in Artificial Intelligence in Education. International Journal of Artificial Intelligence in Education, 26(2), 582–599.

Article Google Scholar

Rummel, N., Walker, E., &Aleven, V. (2016). Different futures of adaptive collaborative learning support. International Journal of Artificial Intelligence in Education, 26(2), 784–795.

Article Google Scholar

Schoenenberger, H. (2019). Preface. In H. Schoenenberger (Ed.), Lithium-ion batteries a machine-generated summary of current research (v–xxiii). Berlin: Springer.

Google Scholar

Selwyn, N. (2019a). Should robots replace teachers? AI and the future of education. New Jersey: Wiley.

Google Scholar

Selwyn, N. (2019b). What's the problem with learning analytics? Journal of Learning Analytics, 6(3), 11–19.

Article Google Scholar

Selwyn, N., Pangrazio, L., Nemorin, S., &Perrotta, C. (2020). What might the school of 2030 be like? An exercise in social science imagination Learning, Media and Technology, 45(1), 90–106.

Article Google Scholar

Sparkes, A., Aubrey, W., Byrne, E., Clare, A., Khan, M. N., Liakata, M., et al. (2010). Towards robot scientists for autonomous scientific discovery. Automated Experimentation, 2(1), 1.

Article Google Scholar

Strobl, C., Ailhaud, E., Benetos, K., Devitt, A., Kruse, O., Proske, A., & Rapp, C. (2019). Digital support for academic writing: A review of technologies and pedagogies. Computers and Education, 131, 33–48.

Article Google Scholar

Templier, M., &Paré, G. (2015). A framework for guiding and evaluating literature reviews. Communications of the Association for Information Systems, 37(1), 6.

Google Scholar

Thelwall, M. (2019). Artificial intelligence, automation and peer review. Bristol: JISC.

Google Scholar

Tsai, Y., &Gasevic, D. (2017). Learning analytics in higher education—Challenges and policies: A review of eight learning analytics policies. ACM International Conference Proceeding Series (pp. 233–242). Association for Computing Machinery.

Tsai, Y. S., Poquet, O., Gašević, D., Dawson, S., & Pardo, A. (2019). Complexity leadership in learning analytics: Drivers, challenges and opportunities. British Journal of Educational Technology, 50(6), 2839–2854.

Article Google Scholar

Tsekleves, E., Darby, A., Whicher, A., &Swiatek, P. (2017). Co-designing design imagination A new approach for debating and priming future healthcare technologies and services. Archives of Design Research, 30(2), 5–21.

Article Google Scholar

Wellnhammer, N., Dolata, M., Steigler, S., &Schwabe, G. (2020). Studying with the help of digital tutors: Design aspects of conversational agents that influence the learning process. Proceedings of the 53rd Hawaii International Conference on System Sciences, (pp. 146–155).

Williamson, B. (2019). Policy networks, performance metrics and platform markets: Charting the expanding data infrastructure of higher education. British Journal of Educational Technology, 50(6), 2794–2809.

Article Google Scholar

Williamson, B., &Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. Learning, Media and Technology. https://doi.org/10.1080/17439884.2020.1798995.

Article Google Scholar

Wilson, J. (2015). The metric tide: Independent review of the role of metrics in research assessment and management. Sage.

Winkler, R. &Söllner, M. (2018). Unleashing the potential of chatbots in education: A state-of-the-art analysis. In: Academy of Management Annual Meeting (AOM). Chicago, USA.

Woolf, B. P., Lane, H. C., Chaudhri, V. K., &Kolodner, J. L. (2013). AI grand challenges for education. AI Magazine, 34(4), 66–84.

Article Google Scholar

Zawacki-Richter, O., Marín, V., Bond, M., &Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—where are the educators? International Journal of Educational Technology in Higher Education. https://doi.org/10.1186/s41239-019-0171-0.

Article Google Scholar

Zeide, E. (2017). The structural consequences of big data-driven education. Big Data, 5(2), 164–172.