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Item Type	Book chapter
Authors	Singh, Divya;Singh, Avani
Publisher	Globethics.net
Rights	Attribution-NonCommercial-NoDerivatives 4.0 International
Download date	2026-11-10 01:34:54
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ROBO-TEACHERS IN THE UNIVERSITY CLASSROOM

PEDAGOGY, PRAXIS, AND STUDENT PRIVACY

Divya Singh and Avani Singh

Introduction

Higher education today is a rite of passage servicing both pedagogical and andragogical needs. Phrases such as lifelong learning, twenty-first century skills, workplace readiness, and digital transformation are now commonplace in the argot of higher education. The COVID-19 pandemic further impelled the acceptance of digital learning and online teaching and created wider spaces for the discourse on – and possibilities of – machine learning and artificial intelligence to define the transformation imperatives of higher education. In addition, the continued decrease in teaching budgets, and the demands for more individualised teaching have led to a search for more adaptive technological solutions.[138] Against this backdrop, there is no gainsaying the creep and uptake of technology into the university learning and teaching milieu, ranging from new digital platforms and systems to

[138] University of Plymouth, "Robots will never replace teachers but can boost children's education," *Science Daily*, 15 August 2018. www.sciencedaily.com/releases/2018/081/180815141433.htm.

chatbots as virtual tutors, and more limitedly to humanoid robots providing student support and a few pilot studies of robots as teachers.

Discussion

The notion of robot teachers engenders a range of emotions from great excitement at one end of the spectrum to horror and disbelief at the other extreme. In 2012, a European survey of 27 000 respondents reported that only 3% of those surveyed agreed that robots should be used in education, with 34% of the sample population believing that robots should, in fact, be banned from 'human areas' such as education.[139] However, as technology has become more ingrained and users become more used to engaging with digital entities, the presence of robots in the classroom is increasingly probable. A statement like this may cause a tsunami of angry rhetoric from educators stressing the shortcomings of intelligent machines to replace the human teacher: notwithstanding, the strategic questions with which future-focused universities must grapple is not *will it happen?* but rather *can robots help teachers improve classroom teaching and learning?*; and, if so, *how much of a role should robots play?* and *what form should their participation take?*

Robots in the Classroom

Several universities globally are already testing robots as teaching assistants and the literature provides a range of interesting examples of artificial intelligence (AI) and robots in the classroom. The responses to this have vacillated between enthusiasm and skepticism.[140] The

[139] Eurobarometer (European Commission) 382, "Public attitudes towards robots: Report," September 2012. https://www.ab.gov.tr/files/ardb/evt/Public_attitudes_toward_robots_2012.pdf.

[140] Organisation for Economic Co-operation and Development (OECD). 2021. OECD Digital Education Outlook 2021: Pushing the frontiers with AI,

following sections look at just two of the various possible options: namely, robots as autonomous educators and robots as teaching assistants.

Robots as Autonomous Educators

There are two possibilities when engaging robo-teachers: the autonomous robot teacher that functions independently in the classroom without external control, and robots presented as if they are autonomous but remotely controlled by a human operator.[141] Sometimes, and especially if the robot is geared to function with people, it may be given humanoid form that imitates human form and behaviour, with some further capability of human-like communication.[142] As noted by Newton and Newton,[143] engineers have made robots which can move around classrooms; ask questions; provide information; note and comment on answers; respond to requests; recognise individual students; and maintain a record of those interactions. While the technology has made unprecedented strides, the reality is that "since the 1920s, educators have looked to 'teaching machines' to provide immediate, individual learning experiences at scale."[144] Indeed, new automated approaches

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blockchain, and robots: Highlights, 5. Available at: https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641530/EPRS_STU(2020)641530_EN.pdf.

[141] Sharkey, A.J.C. "Should we welcome robot teachers?" *Ethics and Information Technology.* 18, 2016, 285. DOI: https://doi.org/10.1007/s10676-016-9387-z.

[142] Newton, D.P. and Newton, L.D. "Humanoid robots as teachers and a proposed Code of Practice". November 5. *Frontiers in Education.* 2019, DOI: https://doi.org/10.3389/feduc.2019.00125.

[143] Newton and Newton, 2019: n.p., op. cit.

[144] Holland, B. "Artificial intelligence". *Getting Smart*, 2020, https://www.gettingsmart.com/2020/01/17/artificial-intelligence-the-new-digital-divide/

have been developed, from eye trackers to the monitoring and analysis of other facial features.[145]

One of the key attractions of the robo-teacher is the potential for totally flexible learning and teaching. In a future fantasy of human teachers being replaced by robot teachers, one of the significant attractions is the possibility for students to learn at any time and from any place. Robo-teachers will not be unionised or have set *working hours* and they will not need to take breaks. Class size is immaterial to a robot teacher, who will respond on an individual basis to each student. AI will power these robots providing them with the capabilities for physical and emotional assessment (albeit limited, as we will see later in the discussion) and concomitant individualised teaching, tailored to whether the student is alert, engaged, tired or simply not able to understand the unit of study. In the last-mentioned instance, the robot teacher can provide a recap lesson in basic concepts that will facilitate better understanding of the more involved concepts or immediately refer the student to remedial resources, which is not always feasible in the human teacher-student-classroom engagement.

Newton and Newton emphasise the further potential for more constructive student engagement in the robot-controlled classroom, arguing that in the traditional student-teacher set-up, the human teacher controls the discussion to which the student responds. However, with a robot, the interaction is more balanced with the student enjoying more opportunities to instigate engagement, as would the case in everyday conversation. Further, they reflect on what they describe as students' *performance emotion* and suggest that talking to a robot could be a much less emotive experience, mitigating the anxiety of being judged and promoting more positive attitudes to learning.[146] According to the

[145] OECD, 2020, op. cit. 5.

[146] Newton and Newton, 2019, op. cit. n.p.

OECD,[147] technology also enables students with special needs to participate in education, with AI facilitating the ability of blind, visually impaired, deaf and hard-of-hearing students to participate in traditional education settings and practices; further to this, it is noted that some smart technologies "facilitate the diagnosis and remediation of some special needs (e.g., dysgraphia) and support the socio-emotional learning of students with autism so they can more easily participate in mainstream education."

On the other hand, reports from NCTEFL India[148] are much less enthusiastic about the autonomous robot teacher. They identified only one positive benefit of having a robot teacher which would be to ensure that the syllabus was completed within the set time. However, whether this is truly a constructive advantage for students remains uncertain for, while the robot teacher follows the course programme according to a set schedule, the human teacher may take longer to complete a unit of work realizing that students are experiencing difficulties with understanding which requires repetition, more examples, or a slower pace.

Sharkey also raises an interesting question around the trust with which students would accept the robot's answers.[149] Studies seem to suggest that the outcome may be more positive when the responses relate to factual or technical issues: however, notes Sharkey "[a] robot that is unable to answer children's questions when they stray beyond the featured topic would probably be viewed quite skeptically by the children it is 'teaching'."[150]

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147 OECD, 2021, op. cit. 6.

148 NCTEFL. 2018. "Human teachers vs robot teachers: Who are the best for the changing times?" May, 9. *NCTEFL India*. Available at: https://medium.com/@NcTeflIndia/human-teachers-vs-robot-teachers-who-are-the-best-for-the-changing-times-f9368b5796aa.

149 Sharkey, 2016, op. cit. n.p.

150 Sharkey, 2016, 286.

Lastly and perhaps most significantly when considering the automation of education and balancing the wonders of technology, none can gainsay the fact that responsive teaching requires human judgement, common sense, often an appreciation of the larger picture and an understanding of the nuance behind peoples' actions, as well as consideration for the values and anticipation of the direction in which events are unfolding.[151] Some may argue that robots could be pre-programmed for such qualities, but the obvious counter-contention is: *Can anyone know every situation that might arise to successfully pre-programme the machine's response?* Summarising the problem Kwok emphasises the intrinsic inability of machines to conduct open ended dialogues and give feedback to open ended questions, nor can they replicate the facial gestures and expressions of human teachers which contributes to the effectiveness of the learning experience.[152] Simply, concludes Kwok "artificial intelligence computer technology is unable to deal with learners' unexpected problems and respond to learners' questions immediately as human teachers do."[153]

Additionally, educators generally agree that in education – both basic education and higher education – there must be some sort of connection or *relationship* between the participants for there to be an effective learning engagement. As pointed out by Belpaeme *et al* "[s]ocial interaction enhances learning between humans in terms of both

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[151] See Heyns reflecting on the use of autonomous robots albeit in situations of extrajudicial, summary, or arbitrary executions). Heyns, C. 2013. Extrajudicial, Summary or Arbitrary Executions. GAOR, 80, U.N. Doc. A/HRC/23/47. April 9.

[152] Kwok, V.H.Y. "Robot vs. human teacher: Instruction in the digital age for ESL learners". 8(7) *English Language Teaching.* 2015, 158-160. http://dx.doi.org/10.5539/elt.v8n7p157.

[153] Kwok, 2015, op. cit. 158.

cognitive and affective outcomes,"[154] and artificial intelligence is perhaps just not there yet.[155] Acknowledging the central importance of social interactions and the student-educator relationship in the learning experience, MIT Media Lab has commenced working on *social robots* to gauge their effect on learning on undergraduate students and older adults at MIT.[156] As defined by Gottsegen, social robots are meant to promote interaction between humans and robots.[157] Early positive results were recorded with the MIT project leader reporting that "it is not just young children who respond positively to social robots . . . We are seeing a social-emotional benefit across age groups."[158] Contributing to this body of knowledge, the study from the University of Twente in the Netherlands suggests that the social connection also seems to be much stronger with physical robots rather than *intelligent tutors* which students view on computer screens.[159] Belpaeme et al made similar findings noting that "[r]obots can be more engaging and enjoyable than a virtual agent in cooperative tasks and are often perceived more positively."[160] Kwok however is less enthusiastic arguing that "insufficient teacher training and guidance may cause the robot to become nothing more than a distracting toy in the classroom. High

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[154] Belpaeme, T., Kennedy, J., Ramachandran, A., Scassellati, B. and Tanaka, F. "Social robots for education: A review", *Science Robotics*, 3(21) 2018, 1. https://doi.org/10.1126/scirobotics.aat5954.

[155] Bushweller, K. "Teachers, the robots are coming. But that's not a bad thing". *Classroom Technology.* January 7 2020, https://www.edweek.org/technology/teachers-the-robots-are-coming-but-thats-not-a-bad-thing/2020/01.

[156] Bushweller, 2020, op. cit. n.p.

[157] Gottsegen, G. "Classroom robots are infiltrating the education industry, but teachers are safe – for now". April 6 2019. *Builtin Beta.* n.p. https://builtin.com/robotics/robotics-in-the-classroom,

[158] Bushweller 2020, n.p.; see also Belpaeme et al 2018: 1, op.cit.

[159] Bushweller 2020, n.p.

[160] Belpaeme et al., 2018, op. cit. 1.

student motivation following the initial introduction of the robot decays rapidly."[161]

Interestingly, a recent UNESCO report observed that while there are some notable exceptions, much AI in education has been designed – whether intentionally or not – to replace some teacher tasks, rather than to assist teachers to teach more effectively. UNESCO suggests that a future possibility is that an AI teaching assistant could help the human teacher with many tasks,[162] including providing specialist expertise or professional development resources, collaborating with colleagues, monitoring the students' performance, and tracking progress over time. However, what and how to teach the students would remain the responsibility and prerogative of the teacher, with the AI's role being limited to making the teacher's job easier and more collegiate.

Robots as teaching assistants and for student support

As opposed to autonomous robot teachers, AI has been positively used to support the learning engagement in the university. *Jill* is an AI teaching assistant, developed to enhance student support at the Georgia Institute of Technology. Its developer, Ashok Goel, explains the reason for Jill: every semester he was receiving more than 10,000 messages from his approximately 300 students, too many for him and his eight teaching assistants to handle. Conscious of the retention crisis in universities and correctly ascribing it to the fact that "one of the main reasons students drop out is because they don't receive enough teaching support," Goel and his team of postgraduate students began to work on Jill.

Interestingly Goel points out that as class size increases, so too does the number of enquiries: however, the number of *different* questions

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[161] Kwok, 2015, 158.

[162] UNESCO. 2021. *AI and education: Guidance for policy-makers*. UNESCO Publishers: France, 18. https://unesdoc.unesco.org/ark:/48223/pf0000376709.

does not go up. Goel and his team tracked almost 40,000 student questions that had previously come up in the different classes and they then began feeding Jill both the questions and answers. By the end of the project Jill was an effective, efficient ninth teaching assistant on the team, receiving positive reviews from the students. Only one student identified that Jill was possibly not a human because '[she] tended to answer questions much faster than the others.'[163]

In the Big Ideas survey conducted by Bushweller with K-12 teachers, notwithstanding the general antipathy to AI robots in the classroom, 44% of the respondents acknowledged that the robots could be of assistance especially with administrative tasks. With reference to student support, 30% believed robots could assist with grading, and 30% recognised a positive role for AI in "translating/communicating with emerging bilinguals."[164] Although referenced for schools, the last-mentioned recommendation may also be something to further consider in the university environment especially regarding additional support for new university entrants required to learn in English, but with only limited understanding of the language.

There is no gainsaying the potential for AI and robots to supplement teaching and facilitate learning. Already many institutions have implemented supplementary education platforms, which use AI algorithms to learn how students in the class engage with the content and their areas of difficulty. Describing the experience:

> "These algorithms learn how the student is engaging with content and which areas they are finding difficult to understand by tracking for example how many times they repeat a video in a given timeframe, how many trials it takes for them to get a practice question correct, and the discussions they have engaged in with other students. Upon learning which parts the students

[163] Bushweller, 2020, n.p.

[164] Bushwell, 2020, n.p.

> need to revise more, the algorithms direct them to more resources for further studying."[165]

Notwithstanding the recorded successes with robots in the classroom, the caution from Fernandez-Llamas *et al.* (2017/2020: 2) is apposite. Recognising how students' attitudes affected the results obtained, but equally noting that most of the research involved only short experiments while the robot was still cool and a classroom novelty, Fernandez-Llamas *et al.* emphasise the need for more research including students' attitudes where the use of robots is a more permanent fixture in the classroom.[166] This is reiterated by Schwartz based on the data from a study at Northwoods Elementary School of Technology and Innovation in North Caroline. Recording heightened levels of engagement and participation by the children engaging with the robot tutor once or twice a month, and a preparedness to focus until the lesson was understood, the class teacher notes:

> "However, I do not feel like it would be as commanding if it was used on a daily basis as an instructional tool, students may lose interest."[167]

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[165] Muzamhindo, H. "Can a robot replace a teacher?" July 24. *Investec Education.* 2020. *https://www.investec.com/en_za/focus/innovation/can-a-robot-replace-a-teacher.html.*

[166] Fernández-Llamas, Camino, Miguel Ángel Conde, Francisco J. Rodríguez-Sedano, Francisco J. Rodríguez-Lera, Vicente Matellán-Olivera. "Analysing the Computational Competences Acquired by K-12 Students When Lectured by Robotic and Human Teachers Can a Robot Teach Computational Principles to Pre-university Students?". *Int J of Soc Robotics*, 2020, 12:1009–1019. Note by the Editor: pagination of the released article differs from the quoted text marked as the 2017 version.

[167] Schwartz, K. „Robots in the classroom: What are they good for?" 27 May 2014, *Mind Shift*. https://www.kqed.org/mindshift/35611/robots-in-the-class room-what-are-they-good-for.

Similarly, Newton and Newton state:

> "Of course, some learning and motivational effects may be due to the current novelty of the robot in the classroom, and it is not entirely certain whether, with familiarity, such benefits will persist. There are indications that they can decline over time."[168]

While initial indications are that machines in the classroom have the potential to assist teaching and support student learning, the only fact that we have at this stage is that *we just don't know enough*. Thus, for now, and accepting that technology will redefine teaching in the future, a controlled adoption - rather than over-reliance - is the safer way to go.[169]

Ethical Considerations

Coupling the benefits of the human teacher with the advantages of complementary student support provided by an algorithm may, at face value, appear to be a constructive approach to teaching and learning in the future-focused university. However, there are ethical considerations to be resolved before this should be entertained by universities. In this context, the reminder from Hanson is apposite: "In higher education … we face a decade in which institutional integrity and legitimacy is under fire."[170] As higher education institutions become adopters of the perceived benefits of technology and especially AI, the duality of the relationship between ethics and technology must consciously align with the broader higher education commitment to academic authenticity and integrity.[171]

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168 Newton, 2019, op. cit. n.p.

169 Kwok, 2015, op. cit. 162.

170 Hanson, 2009, op. cit. 1.

171 Singh, D. and Singh, A. "AI in student recruitment and selection: Artificial intelligence and the need for authenticity and integrity", 20(1) 2021, *The South*

UNESCO identifies some of the key ethical questions that arise as follows: what criteria should be considered in defining and continuously updating the ethical boundaries of the collection and use of learners' data; how might schools, students and teachers opt out from, or challenge, their representation in large data sets; what are the ethical implications of not being able to easily interrogate how AI makes decisions (using multi-level neural networks); what are the ethical obligations of private organizations and public authorities; how does the transient nature of students' interests and emotions, as well as the complexity of the learning process, impact on the interpretation of data and ethics of AI applied in educational contexts; and what pedagogical approaches are ethically warranted?[172]

In a deliberate proactive attempt to protect society against the abuse of AI and new technologies, the European Group on Ethics in Science and New Technologies proposes nine ethical principles and democratic prerequisites when considering a new system: human dignity; autonomy; responsibility; justice, equality and solidarity; democracy; the rule of law and accountability; security, safety, and bodily and mental integrity; data protection and privacy; and sustainability.[173] However, we should also bear in mind the *unknown unknowns*, namely those ethical issues raised by the interaction of AI and education that have yet to be identified.[174]

Some of these standards bear deeper reflection in the context of robo-educators and machines in the classroom.

African Qualifications Framework and the Fourth Industrial Revolution. SAQA: Waterkloof, South Africa, 68. Read the article below in this book as well.

[172] UNESCO, 2021, op. cit. 20.

[173] European Group on Ethics in Science and New Technologies. 2018. *Statement on Artificial Intelligence, Robotics and 'Autonomous' Systems*, 8, http://ec.europa.eu/research/ege/pdf/ege_ai_statement_2018.pdf

[174] UNESCO 2021, ibid.

Student privacy

AI solutions for teaching and learning rely on large amounts of education data, including personal data such as biological markers or facial recognition. Classroom robots will impact student privacy as soon as sensors are used to measure engagement responses and when records are kept.[175] An even greater challenge to privacy is when information gathered is stored by the technology and subsequently accessed by others, or immediately accessed by third parties as part of the further teaching engagement. This must raise an alarm even though the aim may be to provide a better learning experience for the student, especially if the full extent of the third-party access is not made clear to the student at the start of the relationship.

The real-world impact of this concern is illustrated in a report in the Wall Street Journal, which revealed that thousands of Chinese students' data had been exposed on the internet.[176] The cache was connected to a surveillance system labelled 'Safe School Shield' and contained facial identification and location data. As noted in the report, this raises serious questions about school surveillance and cybersecurity measures being taken.

Under South African law for example, the Protection of Personal Information Act 4 of 2013 (POPIA) requires that institutions gathering information on students must ensure, among other things, that (1) the affected students are adequately informed of the intention; and (2) any personal information processed complies with the conditions stated in the Act. Specific to the case of robot teachers is the legislative prescript that personal data may only be processed when, given the purpose, it is relevant, not excessive and there is a valid justification for the

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[175] Sharkey, 2016, op. cit. 283.

[176] Lin, L. "Thousands of Chinese students' data exposed on internet." *Wall Street Journal*, 2020, n.p. https://www.wsj.com/articles/thousands-of-chinese-students-data-exposed-on-internet-11579283410.

processing. Furthermore, the collection of personal information must be for a specific, explicitly defined, and lawful purpose related to a function or activity of the university.[177]

Data protection tends to be better regulated than AI in most countries, although the interplay between the two is in urgent need of further exploration. For example, the only direct guidance under South African law is currently section 71 of POPIA, which provides that data subjects may not be subject to decisions which result in legal consequences or affect them to a substantial degree, which are based solely on the basis of the automated processing of personal information intended to profile such persons. While there are certain exceptions to this, the reality persists that there is very little guidance from a legal perspective on how this provision is to be interpreted. In a report published by the European Parliament on the impact of the General Data Protection Regulation (GDPR) on AI, it was noted while the GDPR generally provides meaningful indications for data protection relative to AI applications, a number of AI-related data protection issues are also not explicitly answered, which may lead to uncertainties and costs. This concern is not unique to the European context and applies equally to data protection frameworks across the globe.

The question is whether universities employing machines in the classroom as educators or teaching assistants will be able to assure compliance with the relevant legal frameworks on privacy to which they are required to comply, especially managing personal information that is voluntarily shared but not intended for further processing. Aggravating the problem, notes Sharkey is the fact that "the mobility and connectedness of robots provide new challenges," and the legal and ethical ramifications are still being explored and debated.[178]

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[177] Singh and Singh 2021, op. cit. 78. Read also directly the chapter below "AI in Student Recruitment and Selection".

[178] Sharkey, 2016, 288.

A further concern focused on the contravention of the students' privacy rights is if the student develops a trusted relationship with the robo-teacher and reveals emotions or confides information not actually intended for third parties. In a separate case study, Kanda et al describe how their classroom robot used RFID tags to maintain records of children's interactions and *friendship groups*,[179] begging the question whether the robot cannot become an unintended surveillance system storing information that may be used in the future for other purposes such as identification of delinquent behaviour or even suspicion of criminal conduct. Exacerbating this concern is the fact that the robot had been programmed to assume that people who freely came together as a group could be categorised as friends. However, experience informs us that this is not necessarily true as people come together for many reasons, raising other questions about the programming assumptions and the possibility for incorrect results.

Algorithm bias and inaccuracies

Favouritism in the classroom is an age-old complaint and there is an argument to be made that robo-teachers would eliminate this problem. However, notes Sharkey, robots are not necessarily fair and unbiased.[180] Because robots are developed and programmed by humans, they can display the conscious or unconscious social and cultural biases of their programmers. The project leader of the MIT study (referred to above) confirms algorithm bias as a definite downside in the debates on AI in the classroom. She notes:

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[179] Kanda, T., Sato, R., Saiwaki, N. and Ishiguro, H. "A two-month field trial in an elementary school for long-term human-robot interaction", 23(5), 2007. *IEEE Transactions on Robotics.* 963.

[180] Sharkey, 2016, 292.

> "For starters, the AI field right now is not diverse or inclusive and that could affect the kinds of technologies being developed and fuel potential biases in the software."[181]

The University of Plymouth and Belpaeme *et al* also identified specific limitations with robots in the classroom with speech recognition, especially where the accents were different to that with which they had been programmed.[182] Identifying one of the key underlying concerns with AI currently namely *algorithmic fairness*, Kuhlman, Jackson, and Chunara point out that the root cause stems from structural social inequalities that are then carried through to the data used to train predictive models and in their ultimate functions.[183] Where there is underrepresentation of particular social groupings such as ethnic and cultural minorities, or gender imbalances in the development sample, an unintended result may be the presentation of structural biases in the AI programme. This is exacerbated when the scientists are equally unaware of or unconscious to the issue and do not specifically accommodate for the vulnerabilities in the model. Such examples militate against one of the fundamental missions of higher education in the twenty-first century namely adaptive teaching to achieve equity in the learning experience. In such cases, while the robot teacher may be able to provide individualised teaching, the learning may be counter-intuitive to the students' needs.

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[181] Bushweller, 2020, n.p.

[182] The University of Plymouth. "Robots will never replace teachers but can boost children's education". 15 Aug. 2018. https://www.plymouth.ac.uk/news/robots-will-never-replace-teachers-but-can-boost-childrens-education, see also Belpaeme et al., 2018, op. cit. 2.

[183] Kuhlman, C., Jackson, L. and Chunara, R. "No computation without representation: Avoiding data and algorithm biases through diversity". Feb. 2020, Preprint, https://www.researchgate.net/publication/339550954_No_computation_without_representation_Avoiding_data_and_algorithm_biases_through_diversity.

Burt also highlights other internal and external sources of "algorithmic misbehavior" which would be critical detractors were such machines to be introduced as teaching alternatives.[184] These include such instances as when the data on which the machine was trained "differs too widely from data in the real world" (a so-called internal cause), or if the algorithm is manipulated through an external attack aimed at altering the programmed algorithm (described as an external cause). A further critical concern is the acknowledgement that bias may not be programmed or result through a hack attack, at all but learned by the machines acting on their own. For example, Amazon's experimental recruitment engine – designed to automate the search for "top talent" – displayed a distinct gender bias towards male applicants when it came to technical positions. It transpired that the computer models had been trained on resumes drawn over the previous ten-year period, a time when the industry was overwhelmingly male dominated. Consequently, the machine learned to penalise resumes that included the word *woman*.[185] In another project, the machines were unambiguously trained to reject candidates with poor English language skills, and, over time, the algorithm taught itself to equate English sounding names generally with acceptable qualifications for the job.[186]

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[184] Burt, A. "The liabilities of artificial intelligence are increasing". 15 June 2020, *Legaltech News*, 4, https://www.law.com/legaltechnews/2020/06/15/the-liabilities-of-artificial-intelligence-are-increasing/?slreturn=20210922140653.

[185] Dastin, J. 2018. "Amazon scraps secret AI recruiting tool that showed bias against women." 10 October 2018. *Reuters*. https://www.reuters.com/article/us-amazon-com-jobs-automation-insight/amazon-scraps-secret-ai-recruiting-tool-that-showed-bias-against-women-idUSKCN1MK08G, Kim, Y., Soyatu, T. and Behnagh, R.F. "Towards emotionally aware AI smart classroom: current issues and directions for engineering and education". *IEEE Access*, 2018. 6. 5308-5331 [online]. Available at: https://doi.org/10.1109/ACCESS.2018.2791861.

[186] www.harver.com/blog/machine-learning-in-recruitment/.

Reacting to the long-term consequences of algorithm bias, Yu points out:

> "While the existence of algorithmic bias alone is bad enough, the problem can be exacerbated by the fact that machines learn themselves by feeding the newly generated data back into the algorithms. Because these data will become the new training and feedback data for machine-learning purposes, algorithms that are improperly designed or that use problematic data could amplify real-world biases by creating self-reinforced feedback loops. As time passes, the biases generated through these loops will become much worse than the biases found in the original algorithmic designs or the initial training data."[187]

Accordingly, stresses Remian:

> "Authenticating the knowledge and predictions of AI becomes more important when AI is used for education since the further spread of inaccurate or outdated content could defy educational goals and further reinforce false information."[188]

However, UNESCO notes:

> "AI is not biased in itself. Instead, if its data are biased or analysed with inappropriate algorithms, the original and perhaps unidentified biases can become more noticeable and have a greater impact. Making these biases noticeable is probably helpful, because it can lead to corrections, but allowing the biases

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[187] Yu, 2019, op. cit. 17.

[188] Remian, D. Augmenting education: Ethical considerations for incorporating artificial intelligence in education, 20 November 2019, 24. Scholar Works at UMass Boston, https://scholarworks.umb.edu/cgi/viewcontent.cgi?article=1054andcontext=instruction_capstone.

> to have a greater impact can lead to prejudicial outcomes and so should be carefully mitigated."[189]

It appears to be clear that many smart technologies and AI-based solutions are not fully mature yet. For example, while some early warning systems now approach good predictive power, most rely on predictors that are no better than a random guess; furthermore, in the areas of student engagement, there has been seen to be a concerning level of inaccuracy in many of the measures used in the field of learning engagement.[190] It is therefore a challenge to ensure that the developed technology solutions perform their tasks with accuracy, taking into account that the current level of imperfection may not necessarily be more imperfect than humans. It must therefore be noted that institutions adopting AI may be creating concrete liabilities in the process. The research illuminates the need for universities considering AI systems to properly understand how and why the robot was trained and who programmed it. Underscoring the need for institutions to proceed with caution, Popenici and Kerr state:

> "With the rise of AI solutions, it is increasingly important for educational institutions to stay alert and see if the power of control over hidden algorithms that run them is not monopolised by the tech-lords… Those who control algorithms that run AI solutions have now unprecedented influence over people and every sector of contemporary society."[191]

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189 UNESCO, 2021, 25.

190 OECD, 2021, 19.

191 Popenici, S.A.D. and Kerr, S. "Exploring the impact of artificial intelligence on teaching and learning in higher education". *Research and Practice in Technology Enhanced Learning*, 12(22) 2017, 4. https://doi.org/10.1186/s41039-017-0062-8.

Equity and the digital divide

A further consideration to flag is the impact of the digital divide, which remains a prevalent concern globally (and particularly in the global south, as well as in rural and peri-urban areas). It has been noted:

> "On the one hand, [smart technologies] clearly do or could help reduce inequity both by increasing access to learning opportunities for all and improving learning effectiveness for those who need it the most. On the other hand, without a widespread and equitable availability of smart technologies, inequity could also rise. They may also leave achievement gaps unchanged or even widened, depending on their differential impact on learners."[192]

For those students who have never encountered such technology – either in the classroom or in their personal lives – the sudden exposure and requisite trust that they will be asked to place in the robot teacher may be startling, uncomfortable and invidious to the student's learning experience. According to Holland:

> "Over the past few decades, artificial intelligence (AI) has created a state of disequilibrium not only in society but also in education. Currently, AI can be found driving search engines; powering adaptive learning platforms and intelligent tutoring systems; enabling text-to-speech, dictation, and translation; and monitoring school security. However, these technologies have flooded education faster than research and policy can keep up. As a result, despite all of its promises, there could be very real and significant consequences – particularly when it comes to digital equity.

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[192] OECD, 2021, 16.

> Educators and policymakers have warned of the effects of the digital divide since the 1990s. Initially, this deficit referred to lack of access with computers and the internet. By 2016, the National Education Technology Plan warned of another issue, an emerging digital use divide, as some students learned to use technology for active construction of knowledge and understanding while others remained passive consumers of digital content. With the continued rise of AI, another chasm may emerge as a result of varying experiences with, and exposure to, this innovation."[193]

In this regard, it should be borne in mind that the elements of trust and acceptability that a robot may have will be more prevalent amongst those students who have been exposed to technology from a young age, with the opposite presenting a risk of exclusion. It therefore cannot be ignored that there is a difference in access to devices and connectivity by students from different groups, notably students from lower socio-economic backgrounds; as such, account must be had to the possibility that these students may not have the devices, the connectivity or the resources that allow accessing and using smart technologies either at the learning institution or at home.[194] It also cannot be ignored that high-quality systems are necessary for the robot teacher to function properly, with basic amenities – such as electricity outages or dropped internet connections – either hindering their ability to teach or rendering it a nullity.

Deception, detachment, and loss of human contact

Continued engagement with social robots can shape social behaviours. As Belapeme *et al.* confirm, social robots have been shown to be quite effective at increasing both cognitive and affective outcomes

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193 Holland, 2020, op. cit. n.p.

194 OECD, 2021, op. cit. 16.

because of their physical presence, appearance, and perceived ability to engage.[195] Sharkey discusses the deception factor when social robots are designed to appear as if they understand human behaviour.[196] In such instances, she notes, "[t]he deceptive appearance of robots as real social entities could lead people to form attachments to them, or to imagine that they were capable of or worthy of attachment."[197] When such attachments begin to inform the social development of (perhaps impressionable) students, there is the potential for in tandem antisocial behaviours to be modelled, or in a worst-case scenario a narcissist may be borne. Examples of social dysfunctionality that may develop include students starting to mimic the robot's communication behaviours without learning the normal reciprocity of give and take that attaches to human-human engagement. Other negative behaviours emerge when people become used to the robots acting on their requests without demur and believe that it is accepted social practice to demand and receive, giving rise to a more selfish, self-centred, inconsiderate, and controlling personality type. Thirdly, students interacting with social robots will quickly grasp that they can speak to and/or treat the robot with disregard, disrespect, or even physical abuse with no associated repercussions for their belligerent conduct. Finally, where robots inspire strong emotional attachment from the human participant, the fact that it is not reciprocated can lead to self-doubt and emotional distress, or a belief that emotional artifice is acceptable and 'faking it is ok'.

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[195] Belapeme et al. 2018, 1, 4-5.

[196] Sharkey, 2016, op. cit. 283. See also Serholt, S., Barendregt, W., and Vasalou, A. "The case of classroom robots: Teachers' deliberations on the ethical tensions", 32(4), 2017, *AI and Society.* 613-31. https://doi.org/10.1007/s00146-016-0667-2.

[197] Sharkey, 2016, 288.

Belpaeme *et al.* point out that:

> "Although advanced sensing technologies for reading gesture, posture, and gaze have found their way into tutoring robots, most social robot tutors continue to be limited by the degree to which they can accurately interpret the learner's social behaviour."[198]

Muddled signals can create confusion in the student's mind, and if such behaviours become learned, could lead to demonstrations of social dysfunctionality.

The negative psycho-social effects of human-machine attachment must be investigated further before robots can be introduced as a more permanent fixture in the learning journey. That said, there is also another school of thought. Gottsegen, for instance, notes, "The robots can't actually sense their [human] affection, of course. But they're built to *seem* receptive to it. And for now, that's good enough."[199]

Considering deception to the teaching project, Sharkey describes programmed humanoid robots that measure students' levels of arousal and then adapt their behaviour to enhance engagement. This, too raises a concern pushing teaching "towards a form of 'edutainment' in which any difficult and potentially boring topics were avoided".[200] Belpaeme *et al.* (2018: 7) also consider the possibility of a more impoverished learning experience, which prioritises what is technologically identified over what is actually needed by the learner.

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198 Belpaeme *et al.*, 2018, op. cit. 2.

199 Gottsegen, G. 2019, op. cit.

200 Sharkey, "Should we welcome robot teachers?", 2016, 288.

Conclusion: Will Robots Replace Teachers in the Classroom?

In 2019, UNESCO published the Beijing Consensus on Artificial Intelligence and Education, which called for AI to empower teaching and teachers.[201] The Report underscores the point that:

> "while AI provides opportunities to support teachers in their educational and pedagogical responsibilities, human interaction and collaboration between teachers and learners must remain at the core of education."

The idea of machines replacing people in the workplace is neither novel nor a simple straightforward response. Several studies are available analysing jobs that are susceptible to automation and the reasons why other job are more protected. Citing statistics from the website *Will robots take my job*, Kupferman notes that teachers are deemed 'totally safe' with a 1% suggestion of complete automation. Similarly, the study by Elliott which discusses the role of AI and technology in replacing human engagement in the workplace, without any reference to the schools, universities, and the teaching profession.[202] In contemplating proclivity to automation, the different studies highlight the following levers as being key to a lower propensity for automation: managing and developing people, applying expertise to decision-making, planning and creative tasks, interface/engagement with stakeholders, and working (physical activities or operating machinery) in an unpredictable environment. On the other hand, notes McKinsey, jobs characterised by "predictable environments" and data collection and processing lend themselves to automation.[203] Applying this lens,

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[201] UNESCO, 2019, 5.

[202] Elliott, 2018.

[203] McKinsey Global Institute. A future that works: Automation, employment, and productivity, Executive Summary, 2017. 6. https://www.mckinsey.com/~/

they highlight the significantly lower potential of education to automation (27%), even lower than job sectors such as arts, entertainment, and recreation (41% automation potential), information (36% automation potential), and management (35% automation potential).[204] Bakshi and Windsor, and Frey and Osborne have also advanced the view that straightforward repetitive tasks will always be more susceptible to autonomous control, whereas robots "will struggle when tasks are highly interpretative, geared at products whose final form is not fully specified in advance, and when work task environments are complex."[205] Emphasising the factors of deeper learning, Frey and Osborne highlight that:

> "…while sophisticated algorithms and developments in MR, building upon with big data, now allow many non-routine tasks to be automated, occupations that involve complex perception and manipulation tasks, creative intelligence tasks, and social intelligence tasks are unlikely to be substituted by computer capital over the next decade or two."[206]

In advancing her view on why robots cannot replace teachers, Middleditch focusses on the crucial development of the critical twenty-first century skills of problem-solving, flexibility, empathy,

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media/mckinsey/featured%20insights/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works-Executive-summary.ashx.

[204] McKinsey Global Institute, 2017, 7-8.

[205] Bakshi, H and Windsor, G. *The creative economy and the future of employment.* 21 April 2015. Nesta, 3-4. Available at: https://www.nesta.org.uk/report/the-creative-economy-and-the-future-of-employment/.

[206] Frey, C.B. and Osborne, M. The future of employment: How susceptible are jobs to computerisation?, 1 September 2013. *Oxford Martin Programme on Technology and Employment.* London, 26-7. https://www.oxfordmartin.ox.ac.uk/publications/the-future-of-employment/.

collaboration and teamwork, reflexivity, and creativity.[207] Serholt *et al* raise a concern that classroom robots that the students perceived as 'too credible' – as a source that knows everything – might result in students becoming over-reliant on the machines and losing their capacity to be critical.[208] Of further concern, Newton and Newton question whether a robot would be able to adequately assess thinking that involves personal values, beliefs, and goals, as in decision-making.[209] The disquiet is markedly higher if the machine is the sole educator as there is the concomitant danger that the robot perspective becomes the complete education. In such instances, all the transformation goals of inculcating twenty-first century skills and deeper learning into the higher education curriculum will be effaced.

For many, university is a rite of passage into adulthood and the workplace. It is the university educators' job to widen horizons, foster curiosity, and prepare students for this new world. Good teaching is undergirded by constant creativity and innovation, and there is no gainsaying the relational psycho-social engagements including empathy and sympathy between the educator and the student. Robotic guidance in this regard would be limited as these responses would have to be artificially programmed. Human teachers on the other hand have the natural ability to read, show and respond to emotions, assisting them to support students to bridge the gap between school and university, and deal with the exigencies of the independent learning environment of the university. As succinctly pointed out by NCTEFL India, human beings display responsive behavioural and psychological reactions that 'define their social skills and interactivity'.[210]

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[207] Middleditch, K. 5 Reasons why robots can't replace teachers. 25 July 2018, 25. *Open University News*, n.p. https://ounews.co/education-languages-health/education/5-reasons-why-robots-cant-replace-teachers/.

[208] Serholt *et al*., 2017, op. cit. 626.

[209] Newton and Newton, 2019, op. cit. n.p.

[210] NCTEFL, India, 2018, op. cit. n.p.

Thus, "How much the technical developments are, it surely is difficult for robot teachers to match up to the 'unique' social skills and cognitive ratio exclusively found in humans."[211]

Teachers in the future should have the time and opportunity to stimulate and positively reinforce the identified skills necessary to succeed in the twenty-first century, while perhaps more mundane administrative tasks and limited student support activities may be taken over by machines. At most, it is suggested, robots can be considered as a complementary tool to improve the academic performance of students.[212]

Furthermore, and as explained by the OECD, while there are good reasons to believe that smart technologies, including AI, can contribute to the effectiveness and cost-efficiency of education systems,[213] there is need for a certain measure of caution to keep in mind for any organization seeking to reap those benefits:

- Smart technologies are human-AI hybrid systems, and as such it is key to involve end-users in their design, give control to humans for important decisions, and negotiate their usage with society in a transparent way in order for it to be both useful and socially acceptable.
- Smart technologies support humans in many ways without being perfect. As such, transparency about how accurate they are at measuring, diagnosing, or acting is an important requirement, although their limits should be compared to the limits of humans performing similar tasks.

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211 NCTEFL, 2018, n.p.

212 Sanchez, H., Martinez, L.S. and Gonzalez, J.D. "Educational robotics as a teaching tool in higher education institutions: A bibliographical analysis." *Journal of Physics: Conference Series*, 2019, 1. DOI: https://doi.org/10.1088/1742-6596/1391/1/012128.

213 OECD, 2021, 6.

- More evidence about effective pedagogical uses of smart technologies in and outside of the classroom, as well as their uses for system management purposes, should be funded without focusing on the technology exclusively.
- The adoption of smart technologies relies on robust data protection and privacy regulation based on risk assessment, but also ethical considerations where regulation does not exist. For example, there is mounting concern about the fairness of algorithms, which could be verified through 'open algorithms' verified by third parties.
- Smart technologies have a cost, and a cost-benefit analysis should guide their adoption, acknowledging that their benefits go beyond pecuniary ones. In many cases, the identification of data patterns allows for better policy design and interventions that are more likely to improve equity and effectiveness. Policy makers should also encourage the development of technologies that are affordable and sustainable thanks to open standards and interoperability.

Absent a crystal ball, none can predict what good higher education teaching will look like in the future and some may argue that the approach of US Supreme Court Justice Potter Stewart (albeit when describing pornography) is appropriate: "I know it when I see it." However, it appears – for now, at least – that robo-teachers will not provide a complete solution in achieving the higher education transformation agenda of education for the common good.[214] Human interaction and a professional trained in pedagogy are key imperatives if we are to successfully achieve these outcomes.[215] Discipline leaders in education describe the science around pedagogy that both ensures constructive alignment of curriculum outcomes and leads to a fruitful

[214] UNESCO, 2015.

[215] Aoun, op. cit. 2018.

learning experience. This would need to be carefully pre-programmed through deep integrated engagement between developers and seasoned educators.

Accepting that higher education is a complex learning engagement integrating discipline knowledge and skills with social consciousness and responsibility, robots may not serve this purpose in the classroom. As noted by NEFTL:

> "However unable to really understand various complex standpoints of human beings, the biggest asset of human teachers is they are 'real with their experiences, knowledge and analytical whereabouts' and is not imposed artificially through software or programming."[216]

And, of course, we need to be thinking more deeply around ethics and the ethical journey that needs to be undertaken before AI and robots are introduced into the classroom particularly the question *How far do we want to delegate the education of the next generation to robots?*. Perhaps, therefore, it is premature to discuss educators being replaced by AI but the compendium of challenges because of fiscal constraints in higher education, coupled with larger class sizes and more diverse student groupings, as well as the need to do more with less, drive a real need for increased technological support. In this milieu the more pivotal role that educators could play is to prepare the teaching project for the influence and responsible use and integration of AI. According to the Beijing Consensus (UNESCO 2019: 5), it is necessary to ensure that the rights and working conditions of educators are protected, and to dynamically review and define educators' roles and required competencies in the context of teacher policies; furthermore, attention should be paid to strengthening teacher training institutions, and

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[216] NEFTL, 2018.

developing appropriate capacity-building programmes to prepare teachers to work effectively in AI-rich education settings.

Succinctly summarizing the educator's role, Bushweller highlights:

> "They need to play a big role in the development of the technologies so that whatever is produced is ethical and unbiased, improves student learning, and helps teachers spend more time inspiring students, building strong relationships with them, and focusing on the priorities that matter most. If designed with educator input, these technologies could free up teachers to do what they do best: inspire students to learn and coach them along the way."[217]

Thus, as the allure and complexity of technology increases, institutions adopting AI must make deliberate efforts to balance the introduction of machines with the expanded values and priorities of higher education outlined in the World Declaration on Higher Education for the Twenty-First Century: Vision and Action (UNESCO 1998).

[217] Bushweller, 2020, n.p.