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Will Artificial Intelligence Enable Open Universities to Regain their Past Glory in the 21st Century?

INNOVATIVE PRACTICE ARTICLE

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ABSTRACT

Leveraging technology to break the iron triangle of access, cost, and quality is a legacy of open universities (OUs), becoming a source of inspiration for higher education in general. Today, OUs face increasing competition from conventional universities, no longer enjoying the first-mover advantages as they did in the earlier years. Can artificial intelligence (AI) enable OUs to stay competitive in the 21st century as other technologies did in the past? This paper first reviews literature on the affordances or (potential) uses of AI for open and distance education and then examines the implications of these affordances for OUs in terms of quality, cost, and access. It concludes by arguing for a systems approach to exploring how OUs can remain open as to people and places as well as to methods and ideas by making creative and innovative uses of AI.

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INTRODUCTION

Of all types of educational institutions, open universities (OUs) are arguably the biggest beneficiary of technological advancements. Historically, OUs pioneered in taking advantage of technology to break the iron triangle of access, cost, and quality, growing into a welcome addition to the global higher education sector (Daniel et al., 2009; Xiao 2018). The successful story of leveraging technology "to provide high-quality education to people who cannot go to university otherwise, increasing access at low cost without undermining quality" has become a legacy of OUs (Xiao, 2023a, p. 246) and a source of inspiration for higher education in general (Xiao, 2018). Wider access, low cost, and high quality are cited as rationales for adopting educational technology by international organizations such as UNESCO (Butcher, 2014) and the World Bank (2020) and national governments (Marín, Peters & Zawacki-Richter, 2022).

Similarly, the promise to break the iron triangle is echoed in the discourse of artificial intelligence (AI). According to HolonIQ, "Education is perhaps one of the most obvious areas for the application of artificial intelligence, with the potential to improve access, dramatically reduce cost and accelerate learning outcomes" (Education Intelligence Unit, 2019). AI in education (AIED) purportedly benefits OUs "in terms of ensuring quality, improving pedagogical methods as well as enhancing the overall teaching and learning experience", catalyzes "a significant and highly intriguing paradigm shift", and greatly shapes "the future of all open and distance learners" (Fadzil & Munira, 2008, p. 1). The advent of generative AI tools such as ChatGPT has maximized one's optimism for the potential of AI to revolutionize open and distance education (ODE). AI is arguably conducive to tackling many challenges in ODE (Dogan et al., 2023). Potential uses of AI in ODE include: pre-counselling and post-guidance, instruction/tutoring, gamification/simulations, immediate feedback, learner support, collaborative environment and community of learning, learner performance evaluation, and training of ODE functionaries according to Gautam and Dua (2021, pp. 64–65).

AIED are normalized in various aspects ranging from learning and teaching to administration with many applications invisible now. According to Zawacki-Richter et al. (2019), AI applications in higher education cover four major areas: profiling and prediction, assessment and evaluation, adaptive systems and personalization, and intelligent tutoring systems, which can be further divided into 17 dimensions. Many AI applications or tools are not new to OUs, especially those in developed countries such as the United Kingdom (UK). That said, "there is actually very little evidence of benefits for almost all the types of AIED" at scale (Holmes, 2023), and "strictly speaking, we do not know for sure if AIED 'works' or not" (Holmes & Tuomi, 2022, p. 545). AIED is yet to be fully understood, more rigorous, longitudinal, large-scale studies are to be conducted, and many practical challenges are to be overcome. Therefore, OUs should take a cautious and informed approach to embedding AIED, ensuring that it can put them significantly ahead of their conventional counterparts as other technologies did in the past. Nowadays, OUs face increasing competition from conventional universities, with "the first-mover advantages that Open Universities had undoubtedly enjoyed in the first 25 years" substantially eroded (Tait, 2018, p. 13). Unless AIED can give OUs a significant advantage over conventional universities, its deployment and implementation may be counter-productive and further disadvantage OUs in the current competition. Therefore, this paper is intended to critique the following question: Can OUs regain their past glory by leveraging AIED to break the iron triangle of access, cost, and quality in the 21st century?

The rest of this paper first reviews relevant literature on the affordances or (potential) uses of AI for ODE and then interprets the review findings through a critical lens, examining their implications for OUs in terms of quality, cost, and access. The paper concludes by calling for taking a systems approach to exploring how AIED can be used to make OUs remain "open as to people", "open as to places", "open to methods", and "open to ideas" in the 21st century (Crowther, 1969).

WHAT DOES THE LITERATURE SAY ABOUT THE AFFORDANCES OF AI FOR ODE?

Personalization and automation are two most frequent themes in the literature of AI-enabled ODE. AIED can "personalize instructional materials, automate routine tasks, and create adaptive assessments" as well as "grade assignments, write more relevant objectives, and

even create courses" (Capitol Technology University, 2023). These two themes account for 76% of the studies in a systematic review of AI in distance education in Brazil (Durso & Arruda, 2022; also see Dogan et al., 2023; Jamalova et al., 2022). For the sake of convenience and also given that personalized learning and adaptive learning seem to somehow overlap and are sometimes used interchangeably (Taylor et al., 2021), this paper uses personalization as an umbrella term to cover both personalized and adaptive learning.

AI-enabled personalization in ODE refers to the ways AI tailors "the educational process to each student's individual learning pace and assigns tasks of increasing complexity" by assessing each student's performance, understanding, skills, and idiosyncratic characteristics and accordingly recommending to him or her the best learning pathway, i.e. what, when, and how he or she should learn (Hamilton, 2020; also see Fadzil & Munira, 2008). Personalization in ODE includes such activities as "profiling learners' prior knowledge, learner styles and learning preferences in order to provide personalized and adaptive learning environments" as well as "providing one-to-one tutoring", "differentiated and personalized education through adaptive content, curricula and feedback" and "adaptive scaffolding in terms of feedback, guidance, recommendation, and other types of help" according to the systematic review by Göçmez and Okur (2023). Other personalized activities include matching learning resources to individual students' personal interests, hobbies, occupations, and professional attributes (Xiao et al., 2018); personalizing "assessments for individual students" (Naidu & Sevnarayan, 2023), for example, adaptive quizzes to support students through learning contents tailored to the needs of each individual student (Ross et al., 2018); personalizing guidance, support, and/or feedback by tailoring learning resources to students' learning patterns, knowledge levels, and/or learning needs (Hwang et al., 2020); and providing exercises, explanations, and assessments based on each student's level of knowledge so that he or she can learn at his or her own pace (Kasneci et al., 2023).

AI-enabled automation refers to "the process of removing the manual involvement of humans in a particular process either with the help of machines or by using software" (Bordia, 2022). In this sense, personalization is a kind of automation which is unique in that it is tailored exclusively to a particular student. Apart from personalization, other types of automated activities in ODE include grading quizzes, tests, exams, and assignments (Bozkurt & Sharma, 2023; Gautam & Dua, 2021; Göçmez & Okur, 2023; Hamilton, 2020); assessing essays and providing feedback (Kasneci et al., 2023; Naidu & Sevnarayan, 2023); answering students' questions (Kasneci et al., 2023; Hamilton, 2020); creating educational resources including lesson plans, assessments, and even whole courses (Bozkurt & Sharma, 2023; Capitol Technology University, 2023); facilitating and encouraging collaboration (Casamayor et al., 2009; Gautam & Dua, 2021; McLaren et al., 2010; Yang, et al., 2007); generating ideas for students' assignments and preparing students for examinations (Naidu & Sevnarayan, 2023); and detecting plagiarism (Fadzil & Munira, 2008; Naidu & Sevnarayan, 2023). These automated activities are related to teaching and learning. Examples of automation in terms of administration are helping students select the most suitable programs, course management, scheduling classes, and general operations of OUs (Fadzil & Munira, 2008; Gautam & Dua, 2021; Kose & Koc, 2014); posting announcements and answering frequently asked questions in relation to routine business (Seo et al, 2021); and providing career advice based on a student's interests, skills, and goals (Bozkurt & Sharma, 2023; Kose & Koc, 2014).

Cost-effectiveness is another theme in the AI-enabled ODE literature. For example, ChatGPT and the like can enable assessments at a lower cost but with increased efficiency and reliability (Kumar et al., 2021; Naidu & Sevnarayan, 2023). AIED can render school education more affordable to people from low-income families, thus facilitating universal access to education (Göçmez & Okur, 2023). That said, there are concerns that AIED may "widen gaps in fairness, access, and learning" (Capitol Technology University, 2023). Related to the cost-effectiveness discourse is the time-saving/workload-reducing argument (Göçmez & Okur, 2023; Hamilton, 2020; Naidu & Sevnarayan, 2023). A typical argument is: AIED can free teachers from routine, repetitive, labour-intensive tasks so that they have more time to devote to more creative work (Goel & Polepeddi, 2016).

Creating virtual learning environments is also referred to as a possible contribution by AI to ODE (Gautam & Dua, 2021; Hamilton, 2020; Jamalova et al., 2022). For example, avatars were used to enable collaboration among physically separate learners in an immersive virtual environment (Heidicker et al., 2017), and virtual reality technology was employed "to enable multiple remote

users to send, share, and experience images from the Solar Dynamics Observatory (SDO) via streaming" (Lee et al., 2021), to teach Chinese calligraphy and painting techniques (Li et al., 2022), and to motivate and socialize distance students (Çoban & Göksu, 2022) while intelligent augmented reality was used to train ODE learners to grasp hands-on skills in simulated settings (Grimmette, 2022; Ryan & Knight, 2023).

CAN AIED ENABLE OUS TO BREAK THE IRON TRIANGLE OF ACCESS, COST, AND QUALITY?

IN TERMS OF QUALITY

Personalization

Personalization is needed to solve the problem of the one-size-fits-all model of education which arguably fails to address "the specific and varied needs of individuals", including not allowing students to progress at their own pace (Pelletier, 2003). Human teachers can personalize education but not at a large scale, which is what AI is supposed to be good at. AI personalizes education by relying on patterns of typicality and access to massive amounts of data, in other words, "assessing learners through overlaying their knowledge and competencies onto those of experts or onto systemically prescribed curricula" (Porayska-Pomsta, 2023), recommending the "best" approach with the "most suitable" contents to him or her and "adequately" pacing the learning process according to his or her performance in the preceding learning tasks. However, patterns of typicality may not be able to cater for individual students' idiosyncratic strengths and weaknesses. Furthermore, instead of adapting to individual students as a human educator usually does, AI has the students adapt to it, a phenomenon whose effects on human cognition and thinking remain unclear (Porayska-Pomsta, 2023).

Personalization covers not only learning resources but also tutoring, curricula, assessments, feedback, guidance, and so on. OUs are providers of qualifications-oriented formal education with set learning resources and intended learning objectives for each course and program. How can learning resources and assessments be tailored to the needs of an individual student? In other words, how can students achieve the same learning outcomes by not studying the same learning resources and/or being assessed by the same criteria? As for other aspects, they can and should be personalized. However, in the context of OUs, first, given that tutors and students are separated from each other in space and time, this asynchronicity allows OU tutors to do a much better job in scaling up personalization than their classroom-based counterparts, not to mention that OU students enjoy more liberty to choose the study pathway they feel most comfortable with. Second, a human tutor's measures to personalize learning may extend beyond content learning to catering for emotional or psychological and even social needs of a particular student. This is what AI systems cannot do but what OU students need most because they tend to "feel alone, demotivated, and disengaged" due to the nature of ODE learning (Göçmez & Okur, 2023). Third, personalization is idiosyncratic; a human tutor can notice the idiosyncrasies of his or her students and make appropriate recommendations accordingly while an AI system cannot because the techniques that the system uses to personalize learning such as pattern recognition and correlational analysis are underpinned by a mechanical, inductivist epistemology according to which all patterns can be described in the same and standardized ways regardless of cultures and contexts (Williamson et al., 2023). Also, a human tutor can take the initiative to intervene if he or she notices anything unusual about a student. In comparison, an AI system does not take any action unless activated. As for pace of learning, unlike campus-based students, OU learners are free to pace their learning suited to their idiosyncrasies within the timeframe of a course or program (Conrad, 2023). The pace that an AI system recommends or prescribes may not be as suitable as a student's own pace.

AI-enabled personalization is a paradox in a sense, likely to "recast and reduce the act of education into an individualized and non-social activity" (Selwyn et al., 2023, p. 19). Overreliance on AI-enabled personalization may "promote individualism at the expense of the collaborative and social aspects of teaching and learning" (Holmes, 2023), downgrading "collaborative learning and collective intelligence" (p. 8), and further escalating the lack of interpersonal and emotional interaction which is often found to be a disadvantage of ODE. By recommending certain learning pathways, the system actually deprives students of a wider range of choices, "more apt to strip away student agency and selfhood" (Watters, 2021, p. 226). "There is a

significant irony and shrewdness to call a standardised, rigid, and depersonalised process of learning and teaching 'personalized education'" (Popenici, 2023, p. 63). Put another way, ideally, AI-enabled personalization can at the most contribute to the qualification function of education – providing students "with the knowledge, skills and understanding and often also with the dispositions and forms of judgment that allow them to 'do something'..." (Biesta, 2009, p. 39), but has hardly anything to do with the subjectification and socialization functions. According to Biesta (2009), socialization "has to do with the many ways in which, through education, we become members of and part of particular social, cultural and political 'orders'" (p. 40) while contrary to socialization, subjectification are "about ways of being that hint at independence from such orders" so that students "become more autonomous and independent in their thinking and acting" (p. 41). Therefore, unless there is robust empirical evidence that AI tools are better than human tutors and more cost-effective, or at least not more costly, AI-enabled personalization does not give OUs an edge over campus-based universities.

Automation

Automation lies at the root of AI (McCorduck, 2004). It is based on the assumptions that we already know how human intelligence works, that learning is what education is all about (Eynon, 2023), that "all significant facets of student activity and the learning process can be captured in data form" (Selwyn, 2022, p. 622), and that such data enables educators to "get insights into students' progress and struggles" (Kizilcec, 2023). Attempts to automate education long predate the genesis of AI, starting from Sidney Pressey's teaching machines in the 1920s and continuing into the 21st century (Blikstein et al., 2022; Watters, 2021).

Nevertheless, the mechanism of human intelligence remains a mystery to some extent, hence largely irreplicable. Furthermore, education is shaped by "cultural, psychological, physical, environmental, developmental, and sociological variables", among other things (Popenici, 2023, p. 37), i.e. Savage's (1972, as cited in Perrotta et al., 2022) "big world", datafication of which is impossible, at least in the foreseeable future. In fact, not all the aspects of Biesta's (2009) qualification function can be clearly described, measured and standardized, not to mention socialization and subjectification. The data captured in the learning process are merely "signifiers whose referent is no longer a human subject but a cluster of correlations" (Bolin & Andersson Schwarz, 2015; also see Prinsloo, 2023). After all, education tends to be emotionally charged as an art and craft while AI is inherently rational as a science. Even the most seemingly "objective" work of administration (see Popenici, 2023) and the most trivial routine classroom activities such as roll call (see Selwyn, 2021) are of social and relational rather than purely procedural nature, hence not harmonizing with automation all the time (Wagener-Böck et al., 2023). Automation of education may lead to many harmful consequences. For example, education will be stripped down to learning at best, hence redefining the identity of an educated person. Education will probably no longer be an unpredictable adventure full of joy, sadness, excitement, discomfort, embodied experience, reasoning, imagination, serendipity, reflection, judgment, and empathy. The work of a teacher will probably be reduced to a functional role (Holmes & Tuomi, 2022). Both teacher and student may lose their individual agency and selfhood in the long run if automation is taken for granted.

Similarly, in ODE, automation "should not be to reduce learning to a set of canned and standardized procedures that reduce the student agency, but rather to enhance human thinking and augment the learning process" (Seo et al., 2021). Therefore, many of the automated teaching-related activities should be handled with caution. For example, it may not be appropriate to trust AI systems with assessments, feedback, and question-answering if these activities involve complex critical, creative and/or innovative competencies, or with generation of content including lesson plans, assessments and even whole courses, all of which are usually course and/or programme-specific as well as institution-specific, with a highly contextualized nature that AI systems may not be competent enough to accomplish. It is against the purpose of education to pursue standardization or consistency at the sacrifice of uniqueness, creativeness and/or innovativeness. Take assessment, AI systems are believed to be able to "ensure consistency and quality in not only the marking standards, but the feedback to learners as well" (Fadzil & Munira, 2008, p. 6) so that there are no longer "disparities in assignment scores and grading techniques between tutors and learning centres" of OUs (p. 5) or no "human bias and human error in the grading process" because large modules no longer need many

human tutors to grade assessments (Naidu & Sevnarayan, 2023). Such practice, however, may stifle uniqueness, creativeness and/or innovativeness rather than encourage these desirable qualities. Acknowledging the limitations of AI systems in this aspect, some researchers suggest cooperation between AI systems and tutors (Holstein et al., 2020) or enactment of the human-in-the-loop by combining stupid tutoring systems with intelligent humans (Baker, 2016). It goes without saying that such initiatives will lead to financial consequences, an issue to be picked up later. On the other hand, given the uniqueness of the OU model, automation of some other teaching-related activities may be desirable, for example, providing tips for assignments as requested by students, generating mock examinations for students to practice before the examination dates, grouping students for collaborative work, and detecting plagiarism.

When it comes to automation of OU administration, AI may play a beneficial role in automating back-end administrative tasks such as logistics, finances, human resources, staff services, class scheduling, course management, general student inquiry and so on if the scale of the institution or the reduction of human input can justify the investment. However, care should be taken in direct interactions with students such as program or course selection advising and career advising. In this case, students should be informed of the availability of human support if they prefer human-to-human communication (Fadzil & Munira, 2008). Care should also be taken, in such work as identifying dropouts and at-risk students, recruiting students, and e-proctoring, to remove or at least minimize possible harms resulting from algorithmic bias as bias in data and algorithm is widely documented (Benjamin, 2019a, b; Everett, 2021; Noble, 2018). Overall, "there are epistemological and indeed formative dimensions associated with many labour-intensive processes, which could lead to more informed and ethical educational decisions" (Perrotta, 2023, p. 123). Therefore, a balance needs to be maintained between automation and human labour.

Virtual learning environment creation

Virtual learning environments are a blessing for OU students. Collaboration, learning hands-on skills, doing experiments and the like are the shortcomings of ODE. Many OUs would rent relevant facilities from campus-based universities over the weekend or summer vacation so that their students could use these facilities to complete coursework. On the other hand, some activities such as medical or chemical experiments are hardly available because they are high-risk in real life situations. However, thanks to the advancements in science and technology, in particular in AI, more and more such activities have moved online and are conducted in realistic simulated settings. Take the OU in the UK, it "secured funding of £5.8m from the Office for Students to develop extended reality studios to expand its teaching and learning with augmented and virtual reality…to create authentic contexts for skills development" (Grimmette, 2022). Attempts were also made to explore "the potential benefits of Augmented Reality (AR) in language learning" (OU, 2022) and to "create an immersive virtual environment that gave students a realistic experience of a modern courtroom within which they could interact with other students" (Ryan & Knight, 2023). Examples are too numerous to list here. The contribution of AI to ODE in this aspect is beyond doubt. A major issue of concern, though, is the cost which will be discussed below.

IN TERMS OF COST

Reducing cost of education is often cited as a reason for adopting AIED. Nevertheless, the research and development (R&D) of AI is expensive and so are its training, running and maintenance (Bheemaiah, 2021; Graesser & Li, 2023; Vanian & Leswing, 2023). For example, it is estimated that subscription "to a full suite of popular generative AI tools and education plug-ins" may cost student about £1,000 a year and that connectivity or mobile data costs should not be underestimated even if some AI tools are open access according to a survey (Attwell, 2023). In the case of AIED, educational institutions and students will have to shoulder not only the running and maintenance costs but also the R&D costs. An AI system is not a one-off investment; a continuing flow of money is needed to sustain its operation. Therefore, AI may not be as financially sustainable as often proclaimed (Chihi & Peral, 2022).

On the other hand, if teachers are freed up from routine time-wasting work and use the time saved to "concentrate on higher-impact tasks, leading to better outcomes and a more fulfilling, effective experience for learners" (Webb, 2022), this can also justify expenditure on AIED, a claim which has yet to be supported by solid evidence. "Research has consistently shown that

automated work rarely leads to less work; rather, when machines and humans work together, it increases people's workload and profoundly rearranges how the work is performed and experienced" (Rensfeldt & Rahm, 2023, p. 26; also see Cavalcanti et al., 2021). For example, teachers often have to spend time verifying the authenticity of student work in case they use AI systems to plagiarize or making sure that the systems' outputs are accurate because accuracy remains an issue of concern (Floridi, 2023). As pointed out by Sperling et al. (2023), "the hidden labor of human actors speaks against the time and cost-saving arguments with which AI in education is so often promoted" (p. 579).

As for OUs, the costs cannot be underestimated, especially "with the price of artificial intelligence increasing proportionately with its complexity and supported use cases", to be specific, what we have in mind in terms of the type of software, the level of intelligence, the amount and quality of data for the system, the level of algorithm accuracy, and the complexity of the AI solution, according to Likhadzed (2023). Given that OUs are qualifications providers, it is imperative for them to prioritize and uphold academic integrity to ensure the credibility of their qualifications and the trust of their students and other stakeholders (Naidu & Sevnarayan, 2023). Therefore, the AI systems that OUs deploy must be customized to cater for the specificity and diversity of use cases, namely their courses and programs, as well as of high quality in the five aspects proposed in Likhadzed (2023). In other words, these systems are not cheap at all. On the other hand, many OU students who are financially underprivileged may not be able to afford the use of AIED. For example, the monthly subscription fee of $42 denies many students of the University of South Africa access to ChatPGT-4 (van Wyk et al., 2023). Longitudinal studies are needed to investigate at what scale and to what extent an OU should use particular AI systems to achieve cost-effectiveness for educational stakeholders but not at the expense of educational quality. Any decision to deploy AI systems should be informed by findings from such studies. Unfortunately, empirical studies on the cost of AI-enabled OU education have yet to be conducted.

IN TERMS OF ACCESS

AI systems are often assumed to be able to "promote educational equity and reduce achievement gaps across different groups of learners" (Holstein & Doroudi, 2021) and "to support learners in contexts where there are few experienced or qualified teachers, such as in rural areas in developing countries" (Holmes et al., 2022, p. 21). For example, in China, "AI has been seen as one of the solutions for the shortage of quality teachers in undeveloped areas" although the reality is far from the intention (Yuan, 2023). Interestingly, the equity discourse is popular in the grand narratives of official documents such as Miao et al. (2021), OECD (2023), and the Office of Educational Technology (2023) while equity or ethics-related topics are rarely mentioned by major AIED companies according to Blikstein et al. (2022).

As is well known, financial difficulties are a key factor leading to poor access to quality education. AI systems, as argued above, are costly. Furthermore, their operation depends on the availability of relevant infrastructure and qualified professionals, among other things. Therefore, only educational institutions in well-resourced areas can benefit from AI systems (if they are indeed useful), further exacerbating inequities in education in poorly-resourced areas. In other words, those "who stand to benefit the most from AI-powered education" are usually not able to reap its rewards, as is evidenced by the situation in the Philippine context (Rodrigo, 2023).

Similarly, widening access to quality education is often related to the claim of cost reduction in the AI-enabled ODE literature (Education Intelligence Unit, 2019; Göçmez & Okur, 2023). However, AI systems are costly, especially when we take into account the customized and diversified nature of these systems which is essential to successful OU education. It is still unknown in what conditions AI systems can make OU education affordable enough to widen access to quality ODE. Furthermore, AI-enabled ODE should be cost-effective not only for the institutions but also for their students. Unless it is affordable to OU students, it cannot sustain wider access. For example, the use of Deep Facial Spatiotemporal Network (DFSTN) to predict students' engagement in online learning (Liao et al., 2021) will have cost implications for both educational institutions and students. Other examples include the uses of Affect-Aware Intelligent Tutoring Systems equipped with wearable physiological sensors to assess learners' emotion in online learning (Alqahtani et al., 2021), Auto Tutor to "classify affect states from intelligent teaching systems to aid in the detection of a learner's emotional state" (Myers, 2021), and virtual learning environments. In

these cases, if OU students do not come to study at a place with necessary equipment provided by the university, they will have to purchase such equipment which may be unaffordable to many of them. Affordability for students is an issue even in developed countries according to Jisc (2023a, b) which show that no suitable device for online learning, poor wifi connection, and high mobile data cost are among the difficulties with digital technologies in learning for a significant percentage of students in both higher education and further education sectors in the UK. Cost-effectiveness for both institutions and students need to be catered for to ensure wider access. However, cost-effectiveness for and accessibility to students are relatively neglected themes on the research agenda of technology-enhanced education (Xiao, 2023a).

(IN)CONCLUSIONS

Can OUs regain their past glory by leveraging AIED to break the iron triangle in the 21st century? In light of the discussion above, there is no conclusive answer to this question. The affordances of AI for ODE are hardly distinguishable from those for campus-based higher education. If these affordances work for OUs, they are equally beneficial to campus-based higher education institutions (HEIs). In this case, OUs do not have any advantage over their counterparts. From the perspective of the iron triangle, AIED has yet to produce robust evidence of its effective contribution to the educational quality of OUs and also at affordable costs, when it comes to personalization and automation. In comparison, virtual learning environments may effectively compensate for what traditional OU education could not provide but may not be cost-effective for both the institutions and the students. Given the high standards that OUs set for their education in order to safeguard academic integrity and their own reputation, AI systems that can meet the needs of OUs will probably be more expensive than those for generic purposes, if they really work. This in turn will impact negatively on access: the less affordable AI-enabled OU education is, the less accessible it is to their students. Like the discourse of quality enhancement, the claims of reducing costs and widening access have yet to be supported by rigorous empirical evidence.

As mentioned above, the establishment of virtual learning environments appears to be the most promising investment in AIED by OUs. AIED may be more affordable to OUs and their students in developed countries than in less developed countries. It is a worthwhile attempt for OUs in developed countries to use AIED to compensate for what OUs cannot offer such as hands-on experience and experiments unless special arrangements are made for students to use the facilities of campus-based HEIs, or for what OU students may not be able to do, for example, field trips and other physically immersive experiences, due to other competing commitments. Even if students have to pay an extra fee, these AI-enabled activities can contribute to both access and quality if students find the opportunity cost favourable. However, alternatives should be available to those who cannot benefit from these AI-enabled solutions, whatever the reason; otherwise, access will be limited rather than widened. As for OUs in less developed countries, investment in this area cannot exceed what the finances of an institution can bear; otherwise, other institutional operations will be compromised.

As argued earlier, generally speaking, OU education is more personalized than conventional classroom-based education. Whether AI-enabled personalization can change OU education for the better and with cost-effectiveness is yet to be confirmed through empirical studies, not to mention that it may deepen alienation inherent to ODE. It is the same case with automaton of many teaching-related activities and those administrative activities which may change a student's life or lead to decisions on how they are treated. Even for those activities, be they teaching or administration-related, which seem to be suitable for automation, no efforts should be spared to ensure that quality can be assured and that the cut in manpower justifies the investment in automation.

Unlike conventional HEIs, OUs are committed to making education accessible to all, especially the underprivileged and disadvantaged who cannot afford campus-based higher education or those who choose to study with OUs due to the high opportunity cost of campus-based education (Xiao, 2023a, b). These cohorts exist all the time in all societies and tend to grow because of the hike in tuition fees of conventional universities. The problem is that campus-based universities, which are latecomers and less experienced in ODE, are now competing for this market share in an attempt to beat OUs at their own game. To survive this competition, OUs should continue to innovate in the time-tested "four opens": "open as to people", "open as to places", "open to methods", and

"open to ideas" (Crowther, 1969). It is continuing innovations in these four aspects rather than blind adoption of AIED that can help OUs regain their past glory. Put specifically, it is imperative to explore how AIED can be used to catalyze innovative quality-assured and cost-effective ways of OU education so that OUs will remain open as to people and places in the 21st century. For OUs to maintain competitiveness, any AI-enabled innovation should centre on the "four opens" with the aim of breaking the iron triangle of access, cost, and quality and the adoption of any AI-enabled innovation should be informed by robust evidence of effectiveness.

AI is not a silver bullet for the challenges faced by OUs although it has a role to play in OU education. To what extent and in what ways it can help OUs break the iron triangle depends on how it is creatively and innovatively leveraged to consolidate their strengths and overcome their weaknesses. This is arguably an uncharted field of research which needs to be explored with a systems approach. OUs should guard against AI ideology, namely "the ways in which human consciousness is manipulated to see digital automation as an important (if not inevitable) means of determining future forms of society and/or economy" (Selwyn et al., 2023, p. 9). Jumping on the AI bandwagon simply for fear of missing out may be counter-productive.

DATA ACCESSIBILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

COMPETING INTERESTS

The author has no competing interests to declare.

AUTHOR CONTRIBUTIONS (CRediT)

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