education sciences

Editorial

Crossroads: Collaboration at the Intersection of Pandemic and Post-Pandemic Times

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1. Introduction

Discussions on the potential for technology to disrupt education have appeared at regular intervals for many years. Various technologies have heralded the end of university teaching as we know it. E-learning in the 90s and early 2000s [1], Second Life in the mid to late 2000s [2], and MOOCs in the 2010s [3] were all supposed to revolutionise the traditional university model. However, prior to the COVID-19 pandemic, real change was remarkably slow and inconsistent [4]. The closure of global education institutions due to the COVID-19 pandemic necessitated a rapid transition to emergency remote teaching (ERT) [5] and saw educators engage with synchronous and asynchronous tools like never before. This rapid transition, and the continued use of certain technologies as a by-product of the pandemic, may function as a disruptive paradigm shift [6] in education, where experiences and practices adopted during a time of crisis have an impact on teaching and learning for years to come. As universities stand at the intersection of pandemic and post-pandemic times, the opportunity exists to explore the strategic potential of collaborative research and knowledge exchange networks between education and computer science academics to foster innovative capacity in both domains and to capitalise on recent experiences. To explore this opportunity, this paper begins by examining the disruptive potential of technology in education. Following this, we outline the opportunities and challenges associated with collaborative research between the education and computer science domains. To conclude, the paper provides recommendations to foster cross-faculty research and innovation.

2. Technological Revolutions and Paradigm Shifts

Research into the disruptive potential of technology in education has a long history. There is an acknowledgment within higher education of the need for change both in the delivery of education and in the practices of higher education staff [7]. However, change has been slow to arrive. The higher education sector globally remains one of the most in-person-oriented and least digitised sectors of developed economies [4]. In fact, data from the United States shows that universities spend less than 5% of their overall budgets on IT spending and that two-thirds of American universities remained focused on pursuing on-campus teaching as their primary means of education delivery [7]. These figures exist in stark contrast to previous 'revolutions' in higher education. Scott [1] argued that e-learning would challenge traditional inflexible delivery mechanisms, while Shabha [8] contended that e-learning would bring about significant organisational change in universities. Singh et al. [9] argued that "e-learning methods will greatly change future higher education systems". Second Life was another contender for revolutionary status. During the mid to late 2000s, there was a surge in interest in Second Life as a virtual world, where universities could house a virtual campus and deliver lectures in a fully realised 3D world. Authors such as Jennings and Collins [2] documented this rise and found increasing

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engagement, especially by North American universities, with bold predictions suggesting that up to 80% of active Internet users would participate in virtual worlds by 2012. MOOCs are probably the most recent contender for the revolutionary crown (although we must acknowledge that VR may be the next hot property). In the early years of the 2010s, MOOCs were said to bring about the end of universities "as we know it" [3]. While MOOCs did experience rapid growth during this period and have contributed greatly to research and innovation in online teaching and learning [10], over time, universities settled back into their familiar rhythm of face-to-face teaching.

Engagement with technology, in general, in higher education is also inconsistent. There is a discrepancy between those that use university learning managements systems as content dumps for lecture notes, and nothing more, and those that engage in innovative practice using a range of digital tools. Even those academics who do turn to technology to support educational access or attainment among learners are faced with mixed results [11]. For example, research has identified negative correlations between access to devices or the Internet and learner educational attainment [12], a clear link between access to technology and learner distraction [11], and a relationship between access to technology in learning settings and declines in literacy and numeracy in recent decades [13]. In addition, educators have been reported as identifying a lack of knowledge and skills as a barrier to engaging with technology to support education, with a lack of training in digital methods being a major concern [14].

The influx of corporate tools into education is also a cause of concern for many researchers and academic staff. Platforms such as Google Classroom and Microsoft Teams, which are used throughout higher and post-primary education, have drawn criticism on several fronts. Authors such as Perrotta et al. [15] have argued that the prescriptive manner in which materials are created and shared on these platforms may stifle educator autonomy and creativity in the organisation, delivery, and assessment of learning. The corporate influence of technology giants is also a concern. Brand allegiance and early familiarity with corporate ecosystems mean these technologies come at a price, which is paid for by staff and students with their potential future loyalty. Similarly, concerns around data use and data privacy have prompted the banning of Google Workspace in Danish schools [16]. The encroachment of tech companies into education is one matter; however, similar concerns are being voiced regarding the rapid growth of artificial intelligence in education. Research by authors such as Bayne [17] and Zawacki-Richter et al. [18] gives voice to the duality that exists within the wider education system between the acknowledgment of the opportunities that AI brings in terms of automation and concerns around the use of staff and student data and a lack of understanding of the inner working of AI and its potential impact on future education delivery.

The disruptive impact of the COVID-19 pandemic is different from the impacts outlined above. It was not driven by technological developments, technologists, digital learning enthusiasts, or corporate influence. Instead, the pandemic forced education institutions and educators (from all levels of the digital capability and digital enthusiasm spectrum) to adopt online or technology-dependent modes of education [4,19]. This removal of an "opt-in clause" for digital and online learning has exposed a huge number of educators and students to tools and processes that they may otherwise never have engaged in [20], providing new and valuable insights into the role of technology from a wider audience of education professionals and academics. Unsurprisingly, many educators reported being unprepared for such a sudden paradigm shift in their roles and their practices, with them lacking the innate technological capacities for online teaching [21]. Research from all levels of education across multiple EU countries identified a lack of technological knowledge and skills as barriers to the successful adoption of digital approaches during the COVID-19 pandemic [14]. The impact of these challenges was exacerbated by a paucity of CPD and technological resources to support educator development in this regard [22]. Notwithstanding the challenges which the COVID-19 pandemic posed, many authors argue that the pandemic has caused a paradigm shift in how many educators and students view the future of education. For example, Zhao and Watterston [23] contend that students are increasingly expressing a desire for more flexible, blended, and technology-supported delivery–even if this is used to support traditional face-to-face lectures and tutorials. The experience of online learning has opened the eyes of many educators to the opportunities that exist in supporting and enhancing teaching and learning with digital and online tools.

The ebb and flow of technology integration, the intermittent integration of digital tools, the rise and fall of technological revolutions in education, and the challenges and opportunities presented by the COVID-19 pandemic suggest that fostering ground-up collaboration between academics from education and computer science background may reap great rewards and address many of the issues identified previously. Educators have a deep understanding of the teaching and learning context and can provide valuable insights on how technology should be designed and implemented to best support learning. They are the end-users of the technology and can provide feedback on its usability, effectiveness, and potential issues. By being involved in the building process, educators can ensure that the technology aligns with their teaching goals and supports the unique needs of their students. They can also develop a sense of ownership and investment in the technology, which can lead to higher levels of adoption and effective use in the classroom. Furthermore, by including educators in the development process, they can acquire new skills and knowledge on the use of technology in teaching, which will be beneficial for both educators and their students.

3. Collaboration across the Disciplines

Solving complex societal problems—such as those under discussion in this paper—requires a multidisciplinary, multifaceted approach [24] that fosters interconnected thinking and collaboration [25] across the computer science and education domains. The "grassroots" collaboration that is needed presents a series of challenges and opportunities that need to be considered. Academics from both domains may have historically rooted perceptions of the nature of research and the value of different data types and research approaches. These cultural differences can cause researchers to become entrenched in their viewpoint and/or result in a lack of understanding and appreciation of alternatives. Historically, this situation has been exacerbated by models of research collaboration which pigeonhole participants from either 'side' into certain stages or aspects of projects, thus reducing the real value of collaborative contributions [25]. Kraus and Sultana [26] and Fitzgerald et al. [27] argue that individuals within different disciplines may have developed cultures of collaboration which can act as hidden barriers and unwittingly hamper engagement with researchers from other fields. These include seemingly mundane issues such as discipline-specific authorship protocols and preferences for publication avenues.

The nurturing of collaboration at an inter-faculty level is also seen as complex. Faculties often operate with their own set of standards and requirements when it comes to research [25]. Workload models and productivity metrics can measure and value slightly different things and can often focus heavily on outputs such as publications and funding successes, missing the early-stage interaction and engagement that is required for new ideas to emerge [28]. These top-down approaches adopted by most institutions [29] can stifle innovative research ideas which may see opportunities emerge over time. The reality is that collaboration remains a process founded on human engagement and interaction that requires ongoing fora that facilitate the development of ongoing relationships where understandings are shared and nurtured. In this context, it seems likely that a more nuanced approach to the measurement and metrication of research outputs would positively influence the ability of education and computer science academics to tackle complex problems from a diverse set of perspectives and domains.

Notwithstanding p challenges, the need for collaborative research continues to expand, with it becoming a central tenet of university and national research and innovation policy. Collaborative research not only provides universities with the scope to tackle broader societal problems but it also has the potential to broaden the relevance and translational reach of academic research more generally [30]. For individual academic staff, there are clear trends in that fostering networks of transdisciplinary collaboration can have benefits for researcher profiles and career progression. Evidence suggests that collaborative research attracts significantly more international research funding, providing researchers with the scope and resources to tackle impactful issues [25], while also attracting significantly more citations [31].

The need for sustained interaction between education and computer science academics has been brought clearly into focus over the course of the COVID-19 pandemic. The paradigm shift which the pandemic brought about has changed staff and learner expectations of what education can and should be and has impacted policy development and implementation. This period, coupled with previous technological "revolutions" in education, has highlighted the opportunities that exist in the collaborative development of EdTech resources and platforms. This not only includes the implementation of finished products but also the consideration of how technological solutions are framed from the outset. The creation of a mix between both "top-down" and "bottom-up" factors which support early and persistent engagement in interdisciplinary research by education and computer science practitioners is vital. Additionally, the development of "top-down" factors which make clear the importance of fostering interdisciplinary research practices by staff in higher education institutions is also important. Such formal recognition of this perspective would establish institutional support for *practices* as well as *outputs* that result from collaboration among staff within their institution. This is key, as such a focus would support the development of interdisciplinary relationships and familiarity across domains, thus overcoming the previously outlined barriers to interdisciplinary research. Given the clear emphasis within both policy and research funding frameworks on interdisciplinary research to address complex societal problems, it is incumbent on institutions to develop such capacity among their staff and networks.

4. Discussion

The COVID and post-COVID eras have demonstrated the complex, interwoven role that computer science and education researchers play in the delivery of education. As we have highlighted above, the potential benefits for both universities and researchers in tackling such interdisciplinary problems, i.e., through increased research funding and impact [32], could be greatly improved through embedded collaborative frameworks that work for both disciplines. While frameworks for collaboration do exist, their focus is primarily on mapping out initiatives with external agencies [33] or scoping issues related to pre-defined opportunities and problems e.g., [25,34], there is a lack of discussion around what universities and academics should do to promote collaboration in the "swampy lowlands" [35] of emerging, ill-defined research opportunities that can only come about through sustained interaction and engagement across the discipline divide. As outlined above, in order to support ongoing engagement within a research and development collaborative process, we propose that universities include the targeting of interfaculty collaborative *processes* and *practices* within their strategic planning alongside the production of interfaculty *collaborative outputs*.

There are many reasons why inter-faculty and interdisciplinary collaboration is relevant at the interface of technology and education. Even before the COVID-19 pandemic, it had become increasingly clear that engagement with technology across the higher education sector had progressed in a highly diverse and multidimensional manner, leading to impacts which extend across disciplinary domains and settings. It can be argued, therefore, that an interdisciplinary response will likely be required in order to navigate the ensuing changes and support professionals working in education at all levels. Changing the skills and practices that educators need to acquire while also altering the medium through which programmes are delivered would likely also have further implications across the entire education domain. Additionally, there are also likely to be both opportunities and challenges for researchers across diverse fields of study. On the one hand, there are opportunities for computer science researchers regarding developing resources to support the greater role of technology in both education programmes and in teachers' practices in classrooms. Equally, there are also opportunities for educators to learn ways in which technology and digital tools can support their engagement with learners and improve their practice. The development of inter-faculty engagement has the potential to create conditions for information exchange [36] (p. 580) and allow professionals from both fields to express ideas using the language of the other, creating opportunities for innovation. While entering into inter-faculty collaboration requires commitment and being comfortable with ambiguity [37], investing in ongoing dialogue and engagement holds great potential for institutional innovation [27]. Meaningful interactions which deliberately explore contested issues, which spark the affective domain and evoke feelings of excitement, awkwardness, and bewilderment can be catalysts for debate and open up avenues for research which otherwise would remain hidden [25].

It is within this context that our argument rests. Given the extent of ongoing change and future potential changes within the interface of technology and education, there is clear social validity in fostering ongoing formal networks of collaboration between education and computer science researchers. Furthermore, given the mixed outcomes from project-led collaborative processes in the development of technological reforms within education, emphasis should focus on non-hierarchical, democratic, and organic processes in exploring future directions rather than collaborative practices focused on the delivery of predetermined outputs. Instead, networks should focus on mechanisms to promote the development of and capture of "ground-up" research ideas. Such an approach would help to close the gap that exists between research policy and funding awards and the practices of both education and computer science academics.

5. Conclusions

The challenges and opportunities presented by technology in education require increasingly multidisciplinary approaches and solutions. In this paper, we have argued that universities can do more to foster a culture of cross-faculty collaboration between education and computer science academics and researchers by adopting bottom-up and top-down approaches, which not only allow academic staff to work on emerging ideas and innovations but also recognise these contributions through formal workload and performance appraisal mechanisms. Notwithstanding the challenges this presents, both in terms of fostering collaboration and creating the necessary networks and structures within universities, we contend that such changes can provide benefits for academics, universities, and society as a whole. Sustained collaboration between academics from the education and computer science fields could result in greater success in research publications and citations, greater success and sustained innovation from funding applications, and a prolonged and more fruitful impact on the integration of technology in education.

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