IEEE EDUCON
Global Engineering Education Conference

STRUCTURED ABSTRACT

The Impact of COVID-19 and "Emergency Remote Teaching" on International Computer Science Education Practitioners

CONTEXT

The COVID-19 pandemic has imposed "emergency remote teaching" across education globally, leading to the closure of institutions across all settings, from schools through to universities. This paper looks specifically at the impact of these disruptive changes to those teaching the discipline of computer science. Drawing on the quantitative and qualitative findings from a large-scale international survey (N=2,483) conducted in the immediate aftermath of closures, implementation of lockdown measures, and the shift to online delivery in March 2020, we report how those teaching computer science across all educational levels (n=327) show significantly more positive attitudes towards the move to online learning, teaching and assessment (LT&A) than those working in other disciplines. When comparing educational setting, computer science practitioners in schools felt more prepared and confident than those in higher education; however, they expressed greater concern around equity and whether students would be able to access the teaching made available online. Furthermore, while practitioners across all sectors consistently noted the potential opportunities of these changes, they also raised a number of wider concerns on the impact of this shift to online, especially on workload and job precarity. More specifically for computer science practitioners, there were concerns raised regarding the ability to effectively deliver technical topics online, as well as the impact on various types of formal examinations and assessment. We also offer informed commentary from this rapid response international survey on emerging LT&A strategies that will likely continue to be constrained by coronavirus into 2021 and beyond.

PURPOSE OR GOAL

We undertook an anonymous survey of international computer science educators on their perspectives as practitioners on the rapid shift to "emergency remote teaching" and transitioning online at the height of the COVID-19 crisis, and what they identify and forecast as its immediate and prospective impacts. The data was collected in the immediate aftermath of the forced institutional lockdowns and shift to online LT&A. It aimed to provide insight into emerging policy and practice; impact on practitioners, institutions and students; how might this change the discipline as a result; and what might this mean for the next academic year and in the longer-term. The analysis and discussion presented in the full paper is based upon the perspectives of n=327 practitioners drawn from across all educational settings, institutions, and the career hierarchy, and what they recognise to be the major consequences of COVID-19, the transition to online LT&A, and the challenges of maintaining "continuity of learning". Their accounts document the hopes and fears of the international computer science education community in the face of seismic and, as may prove to be, inalterable shifts. The majority of respondents tend towards a significantly more positive view of online migration than those working in other disciplines, recognising the opportunities and potential affordances of the crisis; these perceptions were consistent across all educational settings. There were some, albeit a minority, who raised a number of generalisable concerns on the impact of this shift to online and the challenges relating to their roles, their institutions and their sectors as a whole.

APPROACH

The survey aimed to investigate how global computer science education practitioners have viewed the move to online LT&A. The sample was taken from a larger survey in which the target population was those who are actively involved in the delivery of LT&A within the education sector. Those who did not meet this criterion were excluded from analysis post-hoc. We adopted a convenience sampling approach in distributing the Qualtrics survey whereby a link to the survey was shared via mailing lists of professional networks and related education organisations. After excluding those that did not meet the participant requirement, 2,483 international educational practitioners responded to the survey. This included 1,465 respondents from the HE (university) sector (59%) and 1019 respondents from schools (41%). 327 participants indicated that they taught computer science. This included 196 from the HE sector (59.9%), 131 from schools (40.1%). The survey was launched on

26 March 2020 following the announcement of closures across various educational settings in the UK, Europe and USA, and closed four weeks later. Quantitative bivariate chi-square ($\chi 2$) analysis of the key variables was conducted in order to determine overall attitudes to online LT&A and whether there were significant differences between those in computer science and those in other disciplines. Furthermore, comparisons were made between those in schools and HE to establish whether there were significant differences between those working in different educational settings. The qualitative analysis of the open-ended questions used thematic analysis.

ACTUAL OR ANTICIPATED OUTCOMES

The quantitative results from our study shows that those who work in computer science are significantly more likely to say that they felt prepared ($\chi(1)=31.47$, $p<0,001$), confident ($\chi(1)=31.44$, $p<0,001$), supported by their institution ($\chi 2(1)=9.91$, $p=0.002$), held a good working knowledge of appropriate technologies ($\chi 2(1)=63.66$, $p<0,001$), had access to appropriate technologies ($\chi 2(1)= 23.24$, $p<0,001$) and were confident that their students could access online LT&A ($\chi 2(1)=22.51$, $p<0,001$). Those who work in schools (84.3%) were significantly more likely to say they were prepared than those in HE (69%) ($\chi 2(1)=8.39$,$p=0,004$). Practitioners from schools (91.5%) stated that they were significantly more confident than those working in HE (78.7%) ($\chi 2(1)=7.62$, $p=0,006$). Finally, those from schools (39%) were significantly less confident that their students would be able access online LT&A than those from HE (57.6%) ($\chi 2(1)=8,2$, $p=0,004$). Mirroring the quantitative results, the open-ended qualitative responses from school practitioners highlighted the potential benefits that the move to online LT&A will have on education, but with concerns around students' access to the LT&A, appropriate pedagogies for teaching computer science, and general concerns about the impact on staff workload. HE practitioners also recognised the positive impact of the changes on the computer science discipline, but recognising the impact on universities, with concern raised regarding the access to specialist software needed for their courses, alongside a longer-term move to online LT&A. As with school practitioners, concern was raised over the impact on workload; for those in HE there was particular concern about the impact on other aspects of their academic roles and responsibilities, especially research.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Many of the challenges and opportunities presented by COVID-19 and the rapid shift to "emergency remote teaching" as identified in this survey could be applied more broadly across the various international educational settings. In particular, there are significant concerns regarding impact on job precarity and security, career progression, financial sustainability of institutions, robustness of the qualifications and examinations system, issues of equity and access to technology, as well as the health and well- being of practitioners and students due to increased workloads and expectations. However, it was clear that school practitioners were frequently more positive due to the perceived rise in status of their "key worker" role and for their discipline more generally. It is also important to acknowledge the ongoing media narrative regarding online teaching being perceived as lower quality than face-to-face teaching (especially for higher education); however, teaching quality is more important than how lessons are delivered, while technology can be used to improve the quality of explanations and modelling, and can play a role in improving assessment and feedback.

In addition, there are a number of specific issues for computer science practitioners that provides valuable insight and context for the discipline as we move with some uncertainty towards the next academic year and beyond. In particular, the increased prominence of technology in an educational context provides opportunities for showcasing the importance of cross-curricular digital and data skills, as well as the explicit value of computer science as a STEM academic discipline. This clearly resonates with recent international computer science curricula and qualifications reforms, especially as computer science is starting to become increasingly established as a school-level subject. There is also an increasing focus on identifying and refining effective pedagogic approaches for LT&A on key foundation topics in computer science — and especially for CS1 — such as mathematical foundations, programming and cybersecurity. However, there are concerns of top-down, "one-size-fits-all" institutional or national approaches that do not recognise the unique characteristics of LT&A in computer science across the various settings and levels. Based on the data obtained from this rapid response survey of international computer science practitioners, we anticipate further evaluation and development of best practice for online LT&A for computer science as we move into the 2020-2021 academic year and beyond. Furthermore, it is imperative that follow-up studies are conducted to capture the longer-term impact to computer science education, especially as it appears that the virus may have to be tolerated on an indefinite basis.

KEYWORDS

COVID-19; emergency remote teaching; practitioner perceptions; schools; universities; computer science education