CJLT RCAT
Canadian Journal of Learning and Technology
La Revue canadienne de l'apprentissage et de la technologie

Volume 47 (4) Special Issue 2021

Teaching and Learning with Technology During the COVID-19 Pandemic: Highlighting the Need for Micro-Meso-Macro Alignments

Enseigner et apprendre avec la technologie pendant la pandémie COVID-19 : Soulignant la nécessité d'alignements micro-méso-macro

***Joke Voogt**, University of Amsterdam*
***Gerald Knezek**, University of North Texas*

Abstract

All over the world teaching and learning transitioned to forms of online education due to the COVID-19 pandemic. This contribution recognizes challenges that this disruptive change brought about for techers and learners. This paper reflects on these challenges, based on discussions at EDUsummIT2019 in Quebec about the theme "Learners and learning contexts: New alignments for the digital age". Informed by theoretical conceptualization and empirical evidence, micro-meso-macro alignments are identified that need to be in place to move education into the digital age: alignments for quality learning contexts, alignments in support for teachers, and alignments through partnerships.

Keywords: Micro-meso-macro alignments; COVID-19; Pandemic; EDUsummIT; Learning contexts; Teacher support; Partnerships

Resume

Dans le monde [quasi] entier, l'enseignement et l'apprentissage ont évolué vers des formes d'éducation en ligne en raison de la pandémie de COVID-19. Dans cet article, il est reconnu que ce changement perturbateur a entraîné pour les enseignants et les apprenants bien des défis. Nous réfléchissons à ces défis, sur la base des discussions qui ont eu lieu lors de l'EDUsummIT2019 au Québec sur le thème "Apprenant·e·s et contextes d'apprentissage : De nouveaux alignements pour l'ère numérique ". Sur la base d'une conceptualisation théorique et des preuves empiriques, les alignements micro-méso-macro à être mis en place pour faire passer l'éducation à l'ère numérique sont repérés : alignements pour des contextes d'apprentissage de qualité, alignements concernant le soutien aux enseignant·e·s et alignements au moyen de partenariats.

Mots clés : Alignements micro-méso-macro ; COVID-19 ; Pandémie ; EDUsummIT ; Contextes d'apprentissage ; Soutien aux enseignants ; Partenariats

Introduction

On January 30, 2020 the World Health Organization (WHO) declared COVID-19 a public health emergency of international concern and on March 11 recognized COVID-19 as a pandemic affecting all sectors in society, including education (WHO, 2021). One week later, March 17, 2020, schools in 124 countries were (partly) closed, affecting 49% of enrolled learners. One year later, March 17, 2021, schools in 29 countries remain (partly) closed, affecting nearly 10% of school-aged learners (UNESCO, n.d.). For many teachers, learners, and their parents this meant that education was not offered at all or offered at a distance, often with the help of digital technologies. In this contribution, the disruptive change for education is reflected upon from the perspective of the EDUsummIT2019 theme "Learners and learning contexts: New alignments for the digital age". To set the scene, a brief overview is provided of the background and mission of EDUsummIT, then educational challenges observed in the transition to online teaching and learning are discussed. Further, consideration is given to how these challenges relate to alignments identified in previous EDUsummITs–that is, to other alignments that have been identified previously in order to promote moving education into the digital age.

EDUsummIT: Background and Mission

EDUsummIT, the International Summit on Information Technology in Education, began as a follow-up to the publication of the International Handbook of Information Technology in Primary and Secondary Education (Voogt & Knezek, 2008). This handbook was the first to provide a synthesis of 40 years of research on information and communication technology in education. A completely updated revision, the Second Handbook of Information Technology in Primary and Secondary Education was published in 2018 (Voogt et al., 2018).

Discussions between handbook authors, policy makers, and practitioners about the lack of impact of research findings on policy and practice resulted in the first EDUsummIT held in The Hague, The Netherlands, in 2009. Seventy international policy makers, researchers, and practitioners deliberated about the conditions that need to be in place for information and communication technology (ICT) to have a positive effect on teaching and learning. EDUsummIT2009 resulted in a call-to-action for research, policy, and practice. Since the first summit in The Hague, EDUsummIT has become a global community of policy makers, researchers, and educators that aims to move education into the digital age. Face-to-face gatherings of this global community after The Hague summit were organized by UNESCO in Paris, France (2011), Washington D.C., USA (2013), Bangkok, Thailand (2015), Borovets, Bulgaria (2017) and Quebec, Canada (2019) each hosting between 70 and 150 participants from policy, practice, and research covering five continents. Due to the pandemic the next EDUsummIT has been postponed until 2022 and is scheduled to be held in Kyoto, Japan.

For each EDUsummIT meeting an international steering committee and local program committee jointly determine the overarching theme and the subthemes to be discussed in Thematic Workings Groups. Each Thematic Working Group assembles research evidence in an online preparation process before the face-to-face working meeting, where participants relate research

evidence about their theme with experiences from policy and practice. Collaborative action items for research, policy, and practice are formulated and agreed upon during the face-to-face summit gathering. EDUsummITs usually result in an Action Agenda for research policy and practice and scholarly papers in peer-reviewed journals based on the work of the Thematic Working Groups, often in the form of a special issue.

Micro-, Meso-, and Macro-Level Challenges During the COVID-19 Pandemic

The dialog about teaching and learning in the digital age that took place at EDUSummIT 2019 took on new meaning in the context of the COVID-19 pandemic that began a few months after EDUSummIT2019. Early studies about transitioning to online education during the pandemic addressed challenges for students' learning and teachers' teaching (micro-level), course delivery and assessment (meso-level), and the education system (macro-level).

Micro-Level Challenges

Student-related concerns that emerged during the transition to online teaching during the pandemic were: (a) adjustment to online learning; (b) adjustment to studying from home; and (c) mental health issues. Oyedotun (2020) noticed that students had difficulty adjusting to online learning and found online learning a burden. Interaction between students and teachers, as well as with peers, was needed to keep students engaged and to maintain a feeling of students being part of a community (Van Dorresteijn et al., 2020). Because students often had to study from home, they were distracted and found it difficult to cope with study requirements and domestic responsibilities (Daniel, 2020; La Velle et al., 2020; Oyedotun, 2020). Students' lack of self-regulation was one of the most frequently mentioned problems of online education (Van Dorresteijn et al., 2020). Students in developing countries also reported connection problems studying from home (Mishra et al., 2020). Many students experienced stress and anxiety because of the sudden change to online teaching and needed extra counseling (Daniel, 2020; Mishra et al., 2020; Oyedotun, 2020). Students were not only worried about the completion of their program, but also about long-term effects on further studies or their careers (Daniel, 2020).

Teacher-related concerns that emerged during the pandemic included challenges related to (a) teaching from home; (b) teachers' attitudes towards online teaching; and (c) teachers' readiness to teach online. La Velle et al. (2020) found that teachers experienced an increased workload when they had to teach online from home. In a study of Canadian teachers, Sokol et al. (2020) found in that stress and burnout levels resulting from teaching online during the pandemic correlated significantly with teachers' attitudes towards technology and change, and their self-efficacy. The Sokol et al. (2020) study also showed that during the course of the pandemic teachers became less convinced about the possibilities of online teaching, although they found themselves more capable of teaching online than at the start of the pandemic. Teachers found it a major challenge to keep students engaged during online teaching (Oyedotun, 2020).

Howard et al. (2020) profiled four levels of readiness–low, mixed, medium, and high–for secondary school teachers to teach online. Readiness in their study was not only defined in terms of individual characteristics, but also as perceived institutional support. Teachers with low or mixed readiness showed low self-efficacy in teaching online. Teachers in the mixed readiness category

were much more positive about the support offered by their institution in teaching online than the teachers in the low readiness category. Teachers with medium and high readiness profiles showed positive self-efficacy towards online teaching. Teachers in the medium readiness category, however, expected targeted support from their institution in the transition to online teaching. Teachers in the high readiness category felt experienced in online teaching and could be of help in supporting their colleagues. The need for targeted institutional support was also found by others (Mishra et al., 2020; Oyedotun, 2020).

Meso-Level Challenges

Challenges related to the teaching learning process dealt with course delivery and assessment problems. Curriculum requirements were not always matched with the potential of online teaching and learning. Vocational programs in particular had to cope with the challenge that practical skills training and internships were often difficult to enact during the pandemic (Daniel, 2020; La Velle et al., 2020; Mishra et al., 2020). Some studies noticed problems with (formative) assessments in an online environment resulting in (undesirable) increases in multiple choice tests (Oyedotun, 2020), or surveillance at a distance intruding into students' privacy (Kharbat & Abu Daabes, 2021). Van Koeven and Smits (2021) observed and questioned an increase in the use of simple drill and practice programs for teaching basic literacy skills in primary education. Because of regular power outages and connection problems due to low bandwidth, online teaching course delivery was negatively affected (La Velle, 2020; Mishra et al., 2020; Oyedotun, 2020).

Macro-Level Challenges

Challenges at the system-level relate to (a) the availability of resources (including support) and infrastructure; (b) cybersecurity; and (c) the quality of online education. Several studies reported problems with the lack of student resources (computers, tablets, smartphones) and connectivity to fully participate in online teaching and contributed to increased inequality in education (Daniel, 2020; La Velle et al., 2020; Oyedotun, 2020; Mishra et al., 2020). An important condition for quality online teaching is the availability of adequate tools and platforms (Van Dorresteijn et al., 2020). In addition, teachers need timely and targeted support in making appropriate use of these resources (Howard et al., 2020; Mishra et al., 2020). Furthermore, Oyedotun (2020) reported cybersecurity challenges because of the increased use of a large variety of tools in online teaching. Finally, Ali (2020) reported a disconnection between research evidence about quality online education and beliefs of policy makers vs. the larger audience who believe that online teaching is only "second best". Ali argued that such beliefs make it difficult to realize quality online teaching.

The Need for Micro-Meso-Macro Alignments

Although online education cannot account for all the challenges outlined in the previous section, providing quality online education calls for alignments between the micro (teaching and learning practices), the meso (institution), and the macro (system, society) levels. During many discussions at the EDUsummITs alignments have been identified to move education into the digital age based on theoretical conceptualization and empirical evidence. These alignments within and across levels are key to understanding how the potential of digital technologies can be implemented in educational practice (Voogt & Knezek, 2008). Three types of alignments are discussed in the

following sections: (a) alignment for quality learning contexts; (b) alignment in support for teachers; and (c) alignment through partnerships.

Alignment for Quality Learning Contexts

Within the context of formal education, teaching and learning practices in online education need to be well-designed to result in deep learning, high student satisfaction and achievement, and low drop-out rates (Van Dorresteijn et al., 2020). Such a design requires alignment between curriculum, teaching and learning practices and assessment (Cox & Laferrière, 2020; Butler et al., 2018), and consists of high-quality instructional materials, meaningful learning activities, multiple assessments, and a clear structure (Van Dorresteijn et al., 2020). While these are general characteristics of quality teaching and learning, they need specific attention in the transition to online education. For students who participate in online education, in particular, it is important to create an environment in which they feel part of a community of learners (Brown & Campione, 1994; Van Dorresteijn et al., 2020). In the EDUsummIT community there have been many discussions about learning processes with technology (Lai, 2008, 2018) and the use of technology for assessment of, for, and as learning (Webb & Gibson, 2015; Webb & Ifenthaler, 2018). This section focuses on the use of technology applications in designing meaningful learning activities and assessment practices.

Two decades ago Dede (2000) listed affordances of technology for making learning meaningful. A few examples of those mentioned were technology that could (a) realize a curriculum centered around real-world problems (e.g., the river city project; Ketelhut et al., 2010); (b) facilitate guided, reflective inquiry through extended projects; (c) be used for modeling and visualization as powerful means of bridging between experience and abstraction (e.g., simulations and virtual laboratories; De Jong, 2016); and (d) be used to enhance students' collaborative construction of meaning via different perspectives on shared experiences or to include pupils as partners in developing learning experiences and generating knowledge (e.g., Knowledge Forum; Tan et al., 2008). The contribution of Chen and colleagues in this special issue is an example of the latter. While research in the field has demonstrated positive effects for student learning, such uses of technology hardly made it to mainstream educational practices (Heitink et al., 2016; Voogt & Knezek, 2008).

The need for alignments to realize meaningful learning with technology was identified. Firstly, the use of technologies as cognitive tools to support learning cannot be isolated from the psychological and emotional effects of digital technology on learners (Lai, 2018). Secondly, alignment is needed between students' use of technology in formal and informal learning settings (Lewin & Charania, 2018). Thirdly, the affordances of technology need to be integrated with learning and pedagogical goals (Cox & Laferrière, 2020; Forkosh-Baruch et al., 2021; Tan et al., 2021).

Digitally-enhanced assessments can be used for formative and summative purposes. Webb and Gibson (2015) define digitally-enhanced assessment as assessments that:

> [I]ntegrate: 1) an authentic learning experience involving digital media with 2) embedded continuous unobtrusive measures of performance, learning and knowledge, which 3) creates a highly detailed, high resolution data record which can be computationally analyzed and

> displayed so that 4) learners and teachers can immediately utilize the information to improve learning. (p. 676)

Digitally-enhanced assessments allow for so-called quiet or embedded assessments, implying that student data, so-called learning analytics, are captured through algorithms in the software (Webb & Gibson, 2015). Research on digitally-enhanced assessments is emerging and varies from simple drill and practice (Klinkenberg et al., 2011) to complex authentic tasks (Shute & Emihovich, 2018). Learning analytics intend to inform students and teachers about a student's real-time learning using data mining techniques (Ifenthaler et al., 2018). See also the contribution of Majumdar and colleagues in this special issue. Ifenthaler et al. (2018) argue that data mining is rather limited in assessing a student's learning and advocate for a more holistic model that also includes student characteristics, behavior, and curriculum requirements. Several scholars (Forkosh-Baruch et al., 2021; Webb & Gibson, 2015) contend that the data mining algorithms used need to be transparent for teachers so that they are aligned with instructional needs, and teachers can decide whether to use the information to inform their instruction and make responsible use of it.

Alignment in Support for Teachers

Teachers are key in the implementation of online education. Several studies show that not all teachers are prepared to teach online (Baran, 2018; Howard et al., 2020). Research shows that teachers often are not aware of the four competency domains required for online teaching–i.e., interpersonal skills, organizational skills, technological pedagogical content knowledge, and flexibility (Baran, 2018; Van Dorresteijn et al., 2020)–and do not feel competent to teach online (Van Dorresteijn et al., 2020). The study of Howard et al. (2020) showed that the support offered to teachers needs to be aligned with the needs of teachers. Albion et al. (2015) argue that professional support (resources, programs, strategies) needs to be envisioned from the roles teachers have in the (online) teaching and learning process, and support needs to be designed that impacts a teachers' practice. Such support not only needs to focus on the development of competencies in the four domains mentioned above, but also on teacher pedagogical reasoning about technology use in education, in order to align affordances of technologies with the learning activities and educational goals (Forkosh-Baruch et al., 2021). Learning to teach online requires an active role from teachers who experiment with new tools and strategies (with guidance from more experienced colleagues) and have the opportunity to reflect and share with colleagues (Smits et al., 2019).

Howard et al. (2020) observed that not all educational institutions included in their study were ready to teach online. Educational institutions (at all educational levels) need to develop a vision that is shared across levels about technology in the teaching and learning process, in order to determine what is desirable and possible (Twining et al., 2013). Alignment of the beliefs of school leadership and teachers about education and the role of technology in education makes technology integration efforts more effective (Christensen et al., 2018) and helps to design professional support that teachers find to be relevant and fit the local context (Tondeur et al., 2016).

Alignment Through Partnerships

Discussions between researchers, policy makers, and practitioners in the EDUsummIT community emphasize the need for partnerships between various stakeholders in order to make the implementation of technology integration in teaching and learning processes in educational

institutions effective and sustainable. Promising partnerships actively involve various stakeholders early and throughout the implementation process (Niederhauser et al., 2018). Experience in scaling a technology initiative in the use of technology in the education of underserved children in India showed the need to pay explicit attention to not only involving stakeholders, but also aligning vision, understanding, concerns, and motivations among the different stakeholders (government, NGO's, private partners, schools) who collaborated on the initiative (Charania & Davis, 2016). Furthermore, Chen and colleagues (this special issue) argue that to make progress it is important to act as a network-based collective and not hierarchical. Howard et al. (2021) present a model for technology initiatives to be sustainable and scalable. This model describes the need for collaboration between partners (school leaders, teachers, researchers, policy makers) and the need for research that is co-designed, iterative, and longitudinal. Examples are school-university-government partnerships in Canada, such as the Remote Networked Schools initiative in Quebec (Laferrière et al., 2010) and professional development for novice teachers, as reported by Friesen and Brown in this special issue.

Conclusion

Schools in many parts of the world at all levels of the education spectrum transitioned to a form of online education due to the COVID-19 pandemic. Online education is not viewed as a panacea for all the challenges education has been confronted with during the pandemic, but as a major benefit of digital technologies that teaching and learning processes in many places in the world have been able to continue. For online education to have quality, certain conditions need to be in place (e.g., Van Dorresteijn et al., 2020; Cox & Laferrière, 2020). Based on lessons learned from research on technology integration in education and discussions within the EDUsummIT community, it is realized that alignments within and across multiple levels are needed to address challenges of online teaching and learning. This study has addressed these alignments in three clusters: (a) alignment for quality learning contexts; (b) alignment in support for teachers; and (c) alignment through partnerships. Finally, it is recognized that digital technologies are a cultural tool and the implementation of such technologies for meaningful learning is locally defined (Kozma, 2003; Lai, 2018) and therefore dependent on the collaboration between micro-, meso-, and macro- level stakeholders.

References

Albion, R., Tondeur, J., Forkosh-Baruch, A., & Peeraer, J. (2015). Teachers' professional development for ICT integration: Towards a reciprocal relationship between research and practice. *Education and Information Technologies, 20*(4), 655-673. https://doi.org/10.1007/s10639-015-9401-9

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. *Higher Education Studies, 10*(3), 16-25. https://doi.org/10.5539/hes.v10n3p16

Baran, E. (2018). Professional development for online and mobile learning: Promoting teachers' pedagogical inquiry. In J. Voogt, G. Knezek, R. Christensen & K.-W. Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 463-478). Springer International Handbooks of Education. Springer. https://doi.org/10.1007/978-3-319-71054-9_31

Brown, A. L., & Campione, J. C. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 229-270). MIT Press.

Butler, D., Leahy, M., Twining, P., Akoh, B., Chtouki, Y., Farshadnia, S., Moore, K., Nikolov, R., Pascual, C., Sherman, B., & Valtonen, T. (2018). Education systems in the digital age: The need for alignment. *Technology, Knowledge and Learning, 23*(3), 473-494. https://doi.org/10.1007/s10758-018-9388-6

Charania, A., & Davis, N. (2016). A smart partnership: Integrating educational technology for underserved children in India. *Educational Technology & Society, 19*(3), 99-109. Retrieved April 22, 2021 from https://www.jstor.org/stable/jeductechsoci.19.3.99

Christensen, R., Eichhorn, K., Prestridge, S., Petko, D., Sligte, H., Baker, R., Alayyar, G., & Knezek, G. (2018). Supporting learning leaders for the effective integration of technology into schools. *Technology, Knowledge and Learning, 23*(3), 457-472. https://doi.org/10.1007/s10758-018-9385-9

Cox, M,. & Laferrière, T. (2020). EDUsummIT 2019 - Learners and learning contexts: New alignments for the digital age. In P. Fisser, & M. Phillips (Eds.), *Learners and learning contexts: New alignments for the digital age: Report of EDUsummit 2019* (pp. 4-7). https://edusummit2019.fse.ulaval.ca/files/edusummit2019_ebook.pdf

Daniel, J. (2020). Education and the COVID-19 pandemic. *Prospects, 49*(1-2), 91-96. https://doi.org/10.1007/s11125-020-09464-3

Dede, C. (2000). Emerging influences of information technology on school curriculum. *Journal of Curriculum Studies*, *32* (2), 281-303.

De Jong, T. (2016). Instruction based on computer simulations and virtual laboratories. In R.E. Mayer & P.A. Alexander, *Handbook of research on learning and instruction* (2nd ed., ch. 23). Routledge. https://doi.org/10.4324/9781315736419

Forkosh-Baruch, A., Phillips, M., & Smits, A. (2021). Reconsidering teachers' pedagogical reasoning and decision making for technology integration as an agenda for policy, practice and research. *Educational Technology Research & Development*. https://doi.org/10.1007/s11423-021-09966-7

Ifenthaler, D., Geiff, S., & Gibson, D. (2018). Making use of data for assessments: Harnessing analytics and data science. In J. Voogt, G. Knezek, R. Christensen, & K.-W. Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 649-663). Springer International Handbooks of Education. Springer. https://doi.org/10.1007/978-3-319-71054-9_41

Heitink, M., Voogt, J., Verplanken, L., van Braak, J., & Fisser, P. (2016). Teachers' professional reasoning about their use of technology. *Computers & Education, 101,* 70-83. https://doi.org/10.1016/j.compedu.2016.05.009

Howard, S. K., Schrum, L., Voogt, J., & Sligte, H. (2021). Designing research to inform sustainability and scalability of digital technology innovations. *Educational Technology Research & Development, 2021*(January 14), 1-21. https://doi.org/10.1007/s11423-020-09913-y

Howard, S.K., Tondeur, J., Fazilat Siddiq, F., & Scherer, R. (2020). Ready, set, go! Profiling teachers' readiness for online teaching in secondary education. *Technology, Pedagogy and Education, 2020*(November 26), 1-18. https://doi:10.1080/1475939X.2020.1839543

Ketelhut, D. J., Nelson, B. C., Clark, J. E., & Dede, C. (2010). A multi-user virtual environment for building and assessing higher order inquiry skills in science. *British Journal of Educational Technology, 41*(1), 56-68. https://doi:10.1111/j.1467-8535.2009.01036.x

Kharbat, F. F., & Abu Daabes, A. S. (2021). E-proctored exams during the COVID-19 pandemic: A close understanding. *Education and Information Technologies, 2021*(February 15), 1-17. https://doi.org/10.1007/s10639-021-10458-7

Klinkenberg, S., Straatmeier, M., & van der Maas, H. I. J. (2011). Computer adaptive practice of Maths ability using a new item response model for on the fly ability and difficulty estimation. *Computers and Education, 57*(2), 1813-1824. https://doi.org/10.1016/j.compedu.2011.02.003

Kozma, R. B. (Ed.). (2003). *Technology, innovation and educational change: A global perspective.* ISTE.

Laferrière, T., Montane, M., Gros, B., Alvarez, I., Bernaus, M., Breuleux, A., Allaire, S., Hamel, C., & Lamon, M. (2010). Partnerships for knowledge building: An emerging model. *Canadian Journal of Learning and Technology, 36*(1), 1-20. https://doi.org/10.21432/T2R59Z

Lai, K.-W. (2008). ICT supporting the learning process: The premise, reality and promise. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 215-230). Springer.

Lai, K.-W. (2018). The learner and the learning process: Research and practice in technology-enhanced learning. In J. Voogt, G. Knezek, R. Christensen, & K.-W.Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 127-142). Springer International Handbooks of Education. Springer. https://doi.org/10.1007/978-3-319-71054-9_8

La Velle, L., Newman, S., Montgomery, C., & Hyatt, D. (2020). Initial teacher education in England and the Covid-19 pandemic: Challenges and opportunities. *Journal of Education for Teaching, 46*(4), 596-608. https://doi:10.1080/02607476.2020.1803051

Lewin, C., & Charania, A. (2018). Bridging formal and informal learning through technology in the twenty-first century: Issues and challenges. In J. Voogt, G. Knezek, R. Christensen, & K.-W. Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 199-215). Springer International Handbooks of Education. Springer. https://doi.org/10.1007/978-3-319-71054-9_13

Mishra, L., Gupta, T., & Shree, A (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International Journal of Educational Research Open, 1*. https://doi.org/10.1016/j.ijedro.2020.100012

Niederhauser, D. S., Howard, S. K., Voogt, J., Agyei, D., Laferrière, T., Tondeur, J., & Cox, M. (2018). Sustainability and scalability in educational technology initiatives: Research-informed practice. *Technology, Knowledge and Learning, 23*(3)**,** 507-523. https://doi.org/10.1007/s10758-018-9382-z

Oyedotun, T. D. (2020). Sudden change of pedagogy in education driven by COVID-19: Perspectives and evaluation from a developing country. *Research in Globalization, 2*(2020), 1-5. https://doi.org/10.1016/j.resglo.2020.100029

Shute, V. J., & Emihovich, B. (2018). Assessing problem-solving skills in game-based immersive environments. In J. Voogt, G. Knezek, R. Christensen, & K.-W. Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 635-648). Springer International Handbooks of Education. Springer. https://doi.org/10.1007/978-3-319-71054-9_40

Smits, A., Voogt, J., & van Velze, L. (2019). The development of technology integration in a graduate course for practicing teachers. In M. Niess, H. Gillow-Wiles, & C. Angeli (Eds.), *Handbook of research on TPACK in the digital age* (pp. 92-112). IGI Global. https://doi:10.4018/978-1-5225-7001-1.ch005

Sokol, L., Strudel , L., & Babb, J. (2020). I've had it! Factors associated with burnout and low organizational commitment in Canadian teachers during the second wave of the COVID-19 pandemic. *International Journal of Educational Research Open, 2-2*(2021), 1-9. https://doi.org/10.1016/j.ijedro.2020.100023

Tan S. C., Seah, L. H., Yeo, J., & Hung, D. (2008). Online learning communities in K-12 settings. In J. Voogt, & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 249-266). Springer.

Tan, S. C., Chan, C., Bielaczyc, K., Ma, L., Scardamalia, M., & Bereiter, C. (2021). Knowledge building: aligning education with needs for knowledge creation in the digital age. *Educational Technology Research & Development, 2021*(January 11), 1-24. https://doi.org/10.1007/s11423-020-09914-x

Tondeur, J., Forkosh-Baruch, A., Prestridge, S., Albion, P., & Edirisinghe, S. (2016). Responding to challenges in teacher professional development for ICT integration in Education. *Educational Technology & Society, 19*(3), 110-120. Retrieved April 22, 2021, from https://www.jstor.org/stable/jeductechsoci.19.3.110

Twining, P., Raffaghelli, J., Albion, P., & Knezek, D. (2013). Moving education into the digital age: The contribution of teachers' professional development. *Journal of Computer Assisted Learning, 29*(5), 426-437. https://doi:10.1111/jcal.12031

UNESCO. (n.d.). *Education: From disruption to discovery.* https://en.unesco.org/COVID19/educationresponse

Van Dorresteijn, C., Fajardo Tovar, D., Pareja Roblin, N., Cornelissen, F., Meij, M., Voogt, J., & Volman, M. (2020). *What factors contribute to effective online and blended education? (Summary): Research team 'Online education during COVID-19'*. University of Amsterdam. https://pure.uva.nl/ws/files/55408784/Executive_Summary_Review_Online_Education_during_covid_19_.pdf

Van Koeven, E., & Smits, A. (2021). *Hoe effectief en veilig is oefensoftware eigenlijk?[How effective and safe is drill and practice software].* Onderwijsinnovatie en ICT. http://onderwijsinnovatie-ict.blogspot.com/2021/03/hoe-effectief-en-veilig-is.html

Voogt, J., & Knezek, G. (Eds.) (2008). *International handbook of information technology in primary and secondary education.* New York: Springer.

Voogt, J., Knezek, G., Christensen, R., & Lai, K-W. (Eds.) (2018). *Second handbook of information technology in primary and secondary education.* Springer International Handbooks of Education. Springer.

Webb, M., & Gibson, D. (2015). Technology enhanced assessment in complex collaborative settings. *Education and Information Technologies, 20*(4), 675-695. https://doi.org/10.1007/s10639-015-9413-5

Webb, M., & Ifenthaler, D. (2018). Assessment as, for, and of twenty-first century learning using information technology. In J. Voogt, G. Knezek, R. Christensen, & K.-W. Lai (Eds.), *Second handbook of information technology in primary and secondary education* (pp. 581-600). Springer International Handbooks of Education. Springer. https://doi.org/10.1007/978-3-319-71054-9_37

WHO (2021). *Timeline: WHO's COVID-19 response.* https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#!

Authors

Joke Voogt is Professor of ICT and Curriculum at the University of Amsterdam (Department of Child Development and Education) and co-founder of EDUsummIT. Her research focuses on the integration of Information and Communication Technology in curriculum and educational practice in national and international settings. Email: j.m.voogt@uva.nl

Gerald Knezek is Regents Professor of Learning Technologies at the University of North Texas, USA, co-director of the Institute for the Integration of Technology into Teaching and Learning and co-founder of EDUsummIT. His teaching and research focuses on technology integration, measurement of socio-emotional constructs, STEM education, and multidimensional scaling methods. Email: gknezek@gmail.com