Learners and learning contexts: New alignments for the digital age

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LEARNERS AND LEARNING CONTEXTS: NEW ALIGNMENTS FOR THE DIGITAL AGE

Report of EDUsummIT 2019

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About EDUsummIT

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Introduction

The International Handbook of Information Technology in Primary and Secondary Education (Voogt & Knezek, 2008) was the first synthesis of 40 years of research in information technology in primary and secondary education. The Handbook provided evidence that digital technologies have much potential for education as numerous chapters made clear, but the implementation in educational practice has lagged behind research evidence. This outcome was an important reason for the Handbook editors to organize a summit where key policy makers, practitioners and researchers in the field could meet to discuss this outcome and to work together to formulate and implement an agenda aimed at stimulating the use of information and communication technology (ICT) in primary and secondary education. The first EDUsummIT – the International Summit on ICT in Education - was held in 2009 in the Hague (The Netherlands) and was organized with support of Kennisnet (The Netherlands), the International Society of technology in Education (ISTE, USA) and BECTA (UK). Approximately 70 researchers, policymakers, and practitioners spanning six continents attended. The first EDUsummIT resulted in concrete action steps in the form of a Call to Action.

EDUsummIT has as its mission statement:

> *EduSummIT is a global community of policy-makers, researchers, and educators working together to move education into the digital age. The EDUsummIT community recognizes the need to respond to the challenges of a world transformed by globalization and economic transformation, caused to a large degree by the development of digital networking technologies. The EDUsummIT seeks to engage educational leaders from across the world in conversations framed around issues and challenges facing education today and through that dialog, develop action items that are based on research evidence.*

Since 2009 five subsequent EDUsummITs have been held, in 2011 in Paris, France; in 2013 in Washington, D.C., USA; in 2015 in Bangkok, Thailand; in 2017 in Borovets, Bulgaria in 2017 and in 2019 in Quebec City, Canada. The seventh EDUsummIT is planned for Kyoto, Japan in 2021. The number of participants attending has varied between 70 and 150.

Evolution of discussion themes

Central to EDUsummIT meetings are Thematic Working Groups, where policymakers, researchers and practitioners convene for 2.5 days in small-group focused discussions to reach consensus on a specific, predetermined topic. Each EDUsummIT has a specific theme, determined in collaboration between the EDUsummIT Steering Committee and the local host. The themes discussed in the Thematic Working Groups have evolved through the years and are inspired by national and international perspectives (e.g. New Horizon Reports), the

analysis of EDUsummIT participant survey responses (Lai, Voogt, Knezek, & Gibson, 2016), the recent publication of the Second Handbook of Information Technology in Primary and Secondary Education (Voogt, Knezek, Christensen, & Lai, 2018) and the discourse on technology in education in the host region.

Since 2009, the themes discussed in the Thematic Working Groups have become more focused and numerous. Themes that needed further discussion were kept, but with a new, more specific focus for the next EDUsummIT, while themes that generated a general consensus and conclusion were closed and replaced by other urgent themes that emerged on the horizon. The two international Handbooks that inspired the EDUsummIT, have shown that between 2008 and 2018 the goals for information and communication technologies in education have evolved. For the EDUsummIT this evolution meant that the focus on policies and practices for the use of information and communication technologies in education in 2009 changed to a focus on learning, with technology in a supporting or facilitating role in 2019.

EDUsummIT as a knowledge building community

The EDUsummIT started from the understanding that scholarly work does not easily find its way into policy and practice and that this is a joint problem. The dialog between policy makers, researchers and practitioners made the EDUsummIT an open community. According to Lai et al. (2016), a knowledge building community has the following characteristics: '(a) heterogeneity –the composition of the community is diverse and equivalence of expertise is respected; (b) informality –a shared goal is informally developed and agreed upon; (c) interactivity –members fully engage in dialogues and discussions; and (d) effectiveness – outcomes relevant to all members' (p. 7). After the EDUsummIT in 2015 Lai and colleagues surveyed EDUsummIT participants and found that they expressed a strong desire to work together and to initiate change. They felt that the EDUsummIT gatherings resulted in new knowledge and understanding, which was useful and relevant for informing policy and practice on digital technologies in education in their own local contexts. The 2008 and 2018 Handbook section editors are active contributors to EDUsummIT's Thematic Working Groups and many handbook authors have attended one or more EDUsummITs.

Impact

Each EDUsummIT results in concrete outputs in the forms of: a) an action agenda, b) this e-book and c) scholarly papers (often as a special issue) – in order to create impact.

Scholarly impact is sought through peer-reviewed journals, usually in the form of a special issue. Outcomes from previous EDUsummITs have been published in major journals in the field: Journal of Computer Assisted Learning; Education and Information Technologies; Educational Technology and Society; and Technology, Knowledge and Learning. EDUsummIT journal articles have been cited more than 1600 times (June 2019). For the outcomes of EDUsummIT 2019, special issues have been negotiated with Educational Technology Research and Development and the Canadian Journal of Learning and Technology. Furthermore the 2008 edition of the International Handbook of Information Technology in Primary and Secondary Education had more than 373,000 chapter downloads and the second edition of

the Handbook had more than 105,000 chapter downloads during its first year after printed publication (as of December 2019).

Action agendas and this e-book are published and distributed among policy makers and practitioners with the help of EDUsummIT participants. UNESCO hosted the section editors' meeting for the first International Handbook in Paris in 2006. Collaboration with UNESCO continued throughout the EDUsummITs and the preparation of the second Handbook. UNESCO offices are important distributors of EDUsummIT outcomes to policy makers worldwide. In addition, local EDUsummIT hosts involve relevant policy makers in EDUsummIT activities. As EDUsummIT moves into its second decade of hosting bi-annual meetings and disseminating outcomes, it has emerged as a mechanism respected by participants and world organizations alike as an important avenue for fast-tracking answers from research on learning with technology issues through dialog with policy and practice.

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EDUsummIT 2019 - Learners and Learning Contexts: New Alignments for the Digital Age

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About EDUsummIT

This E-book is a collection of outcome reports by the thematic working groups (TWGs) of EDUsummIT2019. EDUsummIT (International Summit on IT in Education) is a global knowledge building community of researchers, educational practitioners, and policy-makers committed to supporting the effective integration of research and practice in the field of IT in education. EDUsummIT was founded in 2007 by the Editors and section Editors of the first edition of the International Handbook of Information Technology in Primary and Secondary Education edited by Joke Voogt and Gerald Knezek (2008). The purpose was to disseminate the output from this handbook to the wider research community, to policy makers (and governments) and leading practitioners to enable them to build on what is already known and published in the handbook about IT in Education.

This EDUsummIT community brings together leading international researchers, practitioners and key policy makers every two years to review the knowledge and practices of IT in Education across the world in order to keep countries up to date on the role, scope and impact of IT in Primary and Secondary Education. Since its inception, EDUsummIT meetings have been held six times, firstly in the Hague (2009), then Paris (2011), Washington D.C. (2013), Bangkok (2015), Borovets (2019) and for this report most recently in Quebec (2019). Between 70 and 140 participants from six continents have attended each of the EDUsummIT meetings. While EDUsummIT participants meet biennially, thematic working groups (TWG) focusing on pertinent research topics in IT and education are formed prior to each Summit to prepare discussion papers. The latest knowledge and thinking provided in these discussion papers are further developed during EDUsummIT meetings. After each previous EDUsummIT, TWG findings have been firstly published in an E-book which is disseminated to all OECD countries and further afield, followed by numerous publications in international journals, reports and by groups and individual participants over the Internet and furthermore presented at major conferences.

As a consequence of the extensive impact of the first edition of the handbook and the previous EDUsummITs and their subsequent public outputs, the publishers, Springer commissioned a second edition of the International Handbook which was published in 2018, edited by founder members of EDUsummIT; Joke Voogt, Gerald Knezek, Kwok-Wing Lai and Rhonda Christensen. This added to the evidence and knowledge in the field, further enriching the work of the 150 participants from 38 countries attending EDUsummIT2019 in September 2019.

To maximize the dissemination of the EDUsummIT's work, each EDUsummIT has been organized in association with international and national organizations actively supporting the use of information technology in education. These organizations include UNESCO, the Society for Information Technology and Teacher Education (SITE), the International Society for

Technology in Education (ISTE), Kennisnet (Netherlands), the International Federation for Information Processing (IFIP), the Association of Teacher Educators (ATE), the Centre de Recherche et d'Intervention sur la Réussite Scolaire (CRIRES) and the Network Échange, Recherche et Intervention sur la SCOlarité: persévérance et réussitE (PÉRISCOPE).

EDUsummIT 2019

EDUsummIT 2019 was hosted by Laval University with additional sponsorship from the Canadian Commission for UNESCO, King's College London, DoCenter (the Netherlands), Ministry of Education (Quebec), CRIRES and PÉRISCOPE. The theme of EDUsummIT2019, "*Learners and learning contexts: New alignments for the digital age"* was chosen to consider misalignments due to the consequences of changing knowledge representations, human computer interactions, blurring of formal and informal learning, changes in leadership patterns and many more emerging influences from IT. These ongoing changes require new alignments between traditional and innovative curricula, between learners and teachers, between learning and assessment etc. with long term implications for policymakers, practitioners and researchers in the digital age. This EDUsummIT is the first to have key deliberations and disseminations of important outcomes in French and English. The preliminary outcomes have already been used as the foundations for the following Francophone conference held at Laval University by the Centre de transfert pour la réussite éducative du Québec immediately after EDUsummIT (October 2nd and 3rd, 2019).

EDUsummIT2019 was co-chaired by Thérèse Laferrière (Laval University) and Margaret J. Cox (King's College London) supported by the EDUsummIT steering committee and the local programme committee, details of which are given in the EDUsummIT Programme and this EDUsummIT2019 E-book (https://edusummit2019.fse.ulaval.ca).

The first output from Edusmmit2019 was "The Action Agendas of EDUsummIT2019" consisting of two-page summaries of each TWGs findings and recommendations and co-edited by Cox and Laferriere (2019). This E-book elaborates on those misalignments which were identified by each of the 13 working groups, listed below, such as those between: curriculum, pedagogy and assessment; the fragmentation between policies and practices; and IT being compartmentalized and not integrated into teaching and learning. From these deductions, each working group has identified emerging questions on how to consolidate what is already known from the global evidence and what new alignments can be formed to help policymakers, practitioners and researchers develop effective strategies to be able to provide education which will make best use of ever changing technologies in a digital world.

TWGs used a variety of technologies (e.g., Google Docs and Community Platforms) to support pre-Quebec discussions. Drafts of the discussion papers were prepared before the Summit. TWG leaders also prepared questions for discussions, with supporting materials (research articles, reports, website links, etc.). During the two and half-day meeting, EDUsummIT participants engaged in intense discussions of key issues and challenges related to TWG themes, and developed recommendations and action plans. There were six breakout group sessions, during which the individual working groups shared their knowledge and identified agreed misalignments and actions to address these. The final group session provided "cross-fertilization" among TWGs, with TWG leaders visiting other groups to share their findings and

elicit feedback. The theme for each working group listed below was chosen by the international EDUsummIT Steering committee after reviewing the outcomes from previous EDUsummITs and the up to date findings published in the second handbook.

Each working group listed below had 2 – 3 internationally renowned experts as invited leaders and included researchers, policy makers and practitioners identified for their specific expertise and knowledge in the relevant fields. The membership of each group is given later in this E-Book.

- TWG 1: Technology developments: how human computer interactions change with technological innovation
- TWG 2: Learners as learning leaders: how does leadership for learning emerge beyond the traditional teaching models?
- TWG 3: Creativity for teachers and teaching
- TWG 4: State of the art in thinking about machine learning: Implications for education
- TWG 5: Safe and responsible Internet use in a connected world: teaching critical thinking and accountability to promote cyber-wellness
- TWG 6: Putting learning back into learning analytics: optimizing learning through analyzing the data
- TWG 7: Connected learning: online human interaction and interaction with digital resources
- TWG 8: Pedagogical reasoning and reflective practice: a framework for teaching in a digital age
- TWG 9: Advancing conceptual models of technology integration in education: implications for researchers, practitioners and policymakers
- TWG 10: New approaches and paradigms for researching digital technologies: achieving scalability and sustainability
- TWG 11: Cross-cultural alignments, fertilization, differentiation: bridging the gaps through technology
- TWG 12: National policies in curriculum reforms: what makes a quality curriculum in a technological era?
- TWG 13: Knowledge building/knowledge creation in the school classroom and beyond

Four plenary sessions, which followed the two introductory sessions, allowed TWGs to share the results of their progressive discussions. A Blogging Team provided ongoing live information on the process and key findings to different international networks and later the key Edusummit2019 results.

For more detailed information, see subsequent publications as well as the *International Handbook of Information Technology in Primary and Secondary Education*. The working group reports are published in the following pages providing detailed strategies and guidelines for policymakers, researchers and practitioners which pave the way for successful new alignments for education in a digital age.

Looking ahead

Research papers developed by the TWGs will also be published as a special issue in Educational Technology Research and Development (edited by Joke Voogt and Gerald Knezek), and in the Canadian Journal of Learning and technology (CJLT) / Revue canadienne de l'apprentissage et de la technologie (RCAT) (edited by Margaret Cox et Therese Laferriere).

The photo album

A selection of photos is included in this report to document the activities undertaken during EDUsummIT 2019. They can also be accessed at http://bit.ly/EDUsummIT_pictures.

Thematic Working Group 1
-
How Will Changes in Human Computer Interfaces Impact Educational Technology?

Members of the group:
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Background

Innovations in technology are challenging our beliefs and practices in teaching and learning. The content-orientated curriculum and lecture-based pedagogy can no longer meet the demands of the 21st-century and the needs of diverse learners. Lately, there has been convergence on the part of educators and learners in responding to the digital age. Curriculum movements such as the Next Generation Science Standards (NGSS) are pushing towards process-orientated learning while students are making use of their electronic devices for learning purposes rather than entertainment alone. Looking to the future, then, we identified six technologies that will impact interfaces and in turn, teaching and learning, in the next 3-5 years: robots, wearables/mobile/sensors and controllers, natural language, AR/VR/3D, the cloud, and learning analytics. These technologies not only afford all learners, struggling learners to accelerated learners, opportunities to have a personalized, authentic, and never before possible learning experience, but they also give access to learning all the time and everywhere.

Alignment issues and challenges

To best leverage the affordances of technology to transform teaching and learning, our group identified five levels of misalignments that need to be addressed:

Cultural level: multimodal real world vs. barren classroom
On a cultural level, there is an artificial division between the real world where students engage with technology in diverse ways (e.g., mobile phones, TV, video games, and etc.) and the barren classroom, where students are asked to put their personal devices away. Rather than unlocking the powerful learning opportunities technology affords, we deliberately lock them away in a classroom setting. Such disconnection between the multimodal real world and the

barren classroom aggravates students' lack of engagement at school. We believe that such fear towards technology at school is detrimental. By not educating our students how to maneuver technology in a mindful manner, not only we are depriving them from a powerful learning tool, but also exposing them to potential risks that comes with the abuse of technology.

Political level: simplistic political discourse vs. complexity in learning

In attempt to make evidence informed policy, policymakers tend to ask researchers and educators an overly simplified question of "what works?". However, learning is such a complex and personal activity, and the answer to "what works" varies across individuals, time and contexts. Dede (2014) maintained a better question to ask would be "what works for whom, when, and in what contexts." It is important for policymakers to recognize technology is not a panacea to address the challenges in education – simply investing in technology infrastructure is not going to improve student learning outcomes.

Institutional level: Student-centered teaching vs. assessment-driven learning

There is a striking misalignment between the student-centered teaching approach and the institutional constraints, such as the demands of standardized testing. Teachers are mandated to cover a certain amount of content within a given time frame and prepare students for tests such as the SAT, which made teachers reluctant to move to a student-centered pedagogy.

Curriculum level: Content-focused curriculum vs. process-focused learning outcomes

The traditional curricula focus on a static body of facts that ought to be memorized and regurgitated with fidelity during assessments. However, knowing the content has lost its value in education with the rise of Internet, which made any information accessible at our fingertip. What is now valued is in the 21st century is rather the ability to, synthesize, apply, and create new information. Nonetheless, many existing curricula are still composed of a static body of factual knowledge that treat learners as consumers rather than involving learners as contributors or creators through dynamic process of knowledge building.

Pedagogical level: Old pedagogies vs. New technologies

The effectiveness of any technology-enhanced resource depends on the capacities of the teachers involved (Fishman & Dede, 2016). However, there exists a lack of teacher preparation and professional development to support teachers to teach with new learning technologies. As a result, technology is typically used as an add-on to improve the traditional way of teaching and learning, e.g., using interactive white board to display presentation (Glover & Miller, 2001) as opposed to transform learning experiences.

To improve student learning, it is not enough to simply introduce the technology to classroom because teachers need not only the technical proficiency but also corresponding pedagogies to capitalize the affordances of technology. For example, learning activities that involve AR require pedagogies, such as participatory simulations and studio-based pedagogy, which differ from the conventional teacher-centered and instruction-based approach (Wu et al., 2013).Yet, most teacher professional development programs at the moment are not effective, offering “fragmented, intellectually superficial” seminars (Borko, 2004, p. 3), which do not provide sustainable and sufficient support for teachers to implement new pedagogies.

At the same time, new alignments are emerging. First of all, our students are ready to embrace new technologies as a learning tool rather than only for entertainment purposes. Collins and Halverson (2009) showed that an increasing number of young people have technology-based learning strengths and preferences. Secondly, new curricula, such as the NGSS (Norris, Krajcik, Soloway, 2018), prioritize process-orientated learning to prepare our students for the 21st century. In addition, new assessments (e.g., embedded stealth assessment) corresponding to process-oriented curricula are being developed to capture a more accurate and holistic picture of the learning process and provide diagnostic feedback. Thirdly, there is an increasing accessibility to technology. The one-device- per-student initiative has given many young people access to laptops, tablets, and cell phones. The cost of VR head mount has also dropped drastically (Cipresso, Giglioli, Raya, & Riva, 2018). Last but not least, the accessibility of technology has blurred the boundary between formal schooling and informal interesting-driven learning outside the classroom. A "new culture of learning" is emerging, where people of all ages can participate in learning activities and communities anywhere and at all time (Collins & Halverson, 2009; Thomas and Brown, 2011).

Strategies and actions

Strategies and actions for policy makers: Develop Coherent Policies

Policymakers should experience the field, and their policy decisions need to be informed by those experiences. Educators and teachers should have involved in the decision making process instead of having policy imposed on them. Also, funding should be allocated for a concerted effort in both research and professional development to bring all K-20 educators into the digital age.

Last but not least, policy makers need to pay attention to the coherence in the curriculum, pedagogy, learning outcomes and assessment in the policy. We believe that many education reforms do not bring the substantial change because they only change one aspect of education at a time. For example, it is problematic introduce competency-based learning outcomes without changing the curriculum, pedagogy and assessment. Problems include: Is it valid to assess competencies using standardized tests? How do students acquire the 21st century competencies by passively sitting in a lecture and regurgitate facts in an exam? Such dissonance not only causes a lot of confusion among teachers in evaluating student work, but also misguide our students by giving them the impression of having more leeway in competency-based learning. Due to such incoherence, we often end up having reforms that appears progressive and promising on paper, but does not bring substantial change.

Strategies and actions for practitioners:

Provide high quality teacher preparation and professional development and build partnerships

We believe that teachers should engage in ongoing, community-based and remunerated professional learning that leverages on their expertise and experience as practitioners.

Teachers tend to teach they way that they were taught. Therefore, we maintained that one of the most powerful ways for teachers to understand and eventually adopt innovative pedagogies is for them to experience by such pedagogies in their own learning. The irony of

teacher preparation is to teach teachers innovative pedagogies through lecturing. Teacher educators should model innovative pedagogies and give teachers opportunities to interact with digital technology from a learner's perspective as well as to reflect from a teaching perspective. In other words, teacher should be able to draw experience from their own learning to guide and inform their practice.

Also, we encourage education practitioners to build partnerships with experts from other fields and industries. For example, educators can leverage on the expertise of organizations, such as NASA to develop cutting-edge content that is compatible with classroom teaching and learning.

Strategies and actions for researchers: Expand Scope of Investigation

As research funds continue to dwindle and simplistic questions such as "what works" dominates the public discourse, researchers are increasingly pressured to gear their research towards finding out "what works" or whether a particular technology is "better" or "more effective". However, the results of such research are not usually productive. For example, in an extensive review, Cuban and Kirkpatrick (1998) found that answers to such questions is usually "it depends," which is rather inconclusive and fruitless.

Biesta (2007) argued that the role of research should not be restricted to answering technical questions of what works, rather, research should also provide new understandings of educational reality and different ways of imagining the future of education. This view resonated with Fishman and Dede (2016), who maintained that rather than continuing asking questions about existent technology, we should reimagine social and technological arrangement to transform teaching and learning.

We therefore encourage researchers to broaden their scope of investigation to the entire learning ecosystem and view technology as one component in support of the system. We also believe that researchers should work in close partnership with practitioners in the field and produce usable knowledge together.

Actions from the TWG

We present here a sampling of the strategic actions currently being undertaken by members of TWG1 towards addressing the challenges and misalignments identified above:

Learning analytics (LA): In Japan, the Ministry of Education plans to introduce e-textbooks in all K-12 schools by 2020. E-book readers will record all reading activities such as page flips, bookmarks and annotations. Using these data, teachers can develop evidence-based teaching strategies to respond to the individual needs of each student. Currently, the University of Kyoto is investigating e-book-based LA at five K-12 schools in Kyoto. The advancement in LA will enable smart interfaces to not only capture the learning processes, but also adapt to the needs of the learners to provide a personalized learning experience (Ogata).

Virtual Reality (VR)/Augmented Realty (AR)/3D/Mixed Realty (MR): NASA Space Science Education Consortium (NSSEC) built a VR clean room, which is a replica of a spacecraft assembly clean room at Goddard Space Flight Center. This VR experience gives students and visitors an idea of what it is like for NASA scientists and engineers during the build phase of a satellite. Various instruments and components of the satellite are interactive, along with a few other surprises. This exploration will lead to a better understanding of NASA mission science and engineering and give users a unique look into Goddard and other NASA facilities that otherwise would not be possible (Winter, Young).

Cloud-based Technology: In a pilot study, 10 teachers (600+ students) in Michigan (USA) are using digital curricula provided by the University of Michigan's Center for Digital Curricula (UM.CDC). Available as OER – Open Education Resources – UM.CDC is providing a full year of NGSS-aligned (Next Generation Science Standards) curricula for 3rd, 4th, and 5th grade – curricula that are easily adaptable by the teachers to their local needs (Norris, Soloway). Cloud based applications such as NetLogo, a multi-agent, programmable modelling environment, was used by third year university students (Khaddage, 2016) at the University of Balamand (UOB) in Lebanon to develop AI models based on agents and the environment. Students were presented with some scenarios, each of which facilitated agent design and simulation, thus satisfying the learning outcomes of the practical work of the course (Khaddage).

Robotics and Programming: Canada is a great example of the variability of the integration of coding and robotics into the curriculum. Ten provinces, three territories, 13 stories! For example, Nova Scotia introduced coding to its curriculum in 2015 in order to promote skills that include problem-solving, teamwork and innovation. Since 2016, British Columbia implemented computational thinking (CT) across its curriculum. In June 2018, the province of Quebec released policies for Information & Communications Technologies (ICT) in Education. Based on international researchers in several countries, the vision of the Digital Action Plan for Education and Higher Education 2018-2023 is the effective integration and optimal use of digital technologies to foster the success of all Quebecers (Davidson, Prévost, Tremblay).

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Thematic Working Group 2
-
Learners as Learning Leaders: How Does Leadership for Learning Emerge Beyond the Traditional Teaching Models?

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Barry Quinn, King's College London, UK
Tengku Faekah Tengku Ariffin, Universiti Utara Malaysia
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Background

As we open up to the broadening of contexts for learning, facilitated by pervasive technology to individual learners, we need to think about how leadership for learning emerges and can be supported beyond the traditional teaching models in a technology-enriched environment. In formal as well as in informal contexts, learning leaders, willing to take responsibility for learning in their context, develop new technical competencies. Consequently, their capacity for innovation along the broad spectrum of human activity is enhanced and continues to evolve. Learning leaders, which may include teachers, students and other educators, manifest their leadership through boundary spanning, deep understanding of authentic problems, relational agency, engaging in problem solving, overcoming design challenges, game playing, etc.

The Working Group initiated the discussion on-line prior to the meeting around the following case.

An Illuminating Example of Student Learning Challenges

Learners as leaders of learning is a complex phenomenon that can occur in educational settings, both formal and informal, for different groups: students, teachers, administrators, etc. To initiate our interactions, we proposed a mini-case that involves students.

A number of small-group activities were recorded as part of the project *Creating, Collaborating, and Computing in Mathematics* (CCC-M), a research-practice partnership joining researchers from McGill University with educational consultants, school directors, and teachers from Riverside School Board (Quebec) to address issues of teaching and learning in mathematics.

Here, eighth grade students were placed in groups of three and tasked with finding how much wrapping paper they would need to wrap a box.

Figure 1 Eight-grade students working on a task

As soon as the teacher finishes explaining the task, Angela (middle) begins telling her two group members how they will solve the problem. "*So, we'll each get a side. Which side do you want?*" After hesitant shrugs from Liz (left) and Terrance (right), she delegates the sides to her teammates. The students use rulers to measure their side of the box. Angela writes down her own measurements and begins tapping out her calculations on her brand new iPhone. Liz and Terrance also take their measurements, but do their calculations on classroom calculators. At this point, Angela reminds them, "*Oh and guys, you gotta times it by 2, don't forget.*" She continues working before adding, "*Ok, so I'm gonna draw it. You guys, you might wanna draw it too, just to understand, like, what everything is.*" As everyone finishes their calculations, Angela asks, "*Did you guys find your area yet?"* After an unenthusiastic "*yeah*" from Liz and Terrance, Terrance verbally gives his results. Liz, however, does not get an opportunity to say her results because Angela simply takes her paper and copies down her work. Angela proceeds to complete the last calculation alone and simply recites the final solution for Liz and Terrance to copy.

The initial discussion questions included the following:

- How can we understand what Angela is doing? Why might she be acting in this way? How can we support Angela in developing a better version of leadership for learning?
- How can we support learners like Liz and Terrance in situations like these? How does leadership for learning apply to them?
- How can we scaffold leadership for learning in different dimensions that make the leadership positive?
- What models of leadership do learners have access to in today's classrooms?
- What is most relevant and important in models of leadership to understand the specific dimensions of leadership for learning. Or do we need a new model?
- What is the place of technology for supporting leadership for learning?
- How might IT, or digital tools, "expand" the experience of leadership for learning?

In a world where, because of the possibilities offered by digital tools and the social transformations they enable, learning is increasingly taking place in informal contexts, outside traditional teaching situations, learning can be understood (again) as a distributed activity within informal groups, learning communities, or communities of practice, without a person being explicitly and formally designated as a "guide", as a "teacher" (Rogoff, Matusov, & White, 1996; Rogoff, Callanan, Gutiérrez & Erickson, 2016). Even within the classroom, as in the above case, students are called to work in groups to learn. In this context, how do these roles of teacher or guide emerge within the group? Essentially, it is about the learner taking responsibility for learning, for the learning of others and for his/her own. Taking responsibility for "the well-being of learning" (Olson, 2009). What kind of leadership, then, is being solicited? How does it develop? And how can digital tools support this empowerment.

Alignment issues and challenges

As preparation for diving into issues and challenges, this Working Group reviewed the online exchange of ideas (see above) and identified the following key ***guiding principles*** and underlying assumptions that we shared about leadership for learning and IT:

- Lead learners need to interact collaboratively, build relationships and trust, and ensure continuous development;
- Leadership for learning is distributed amongst participants and dependent on the opportunities present in different situations;
- "IT" should also stand for "innovative teaching", not just for "information technologies": technology should not be the main topic but it should be integrated.

Then we identified the following **main issues**. There is a lack of shared principles or guidelines for understanding learning, leading, IT, and change. This is accompanied by conflicting understandings of student success and wellbeing: competitive versus collaborative views of learning, making the grades versus having deep understandings, being successful versus enjoying a healthy life, etc. There is also an enduring misunderstanding of information technology as a potential "silver bullet", a product that is compartmentalized outside of the ongoing activity systems of teaching and learning and, coming from outside, having a miraculous potential to improve education, viewing it as a "market" (Stoll, Bolam, Collarbone, 2002). Many of us, as exemplified in chapters of the handbooks produced by previous EduSummITs, believe instead that IT needs to be considered as an integral part of re-thinking and expanding teaching and learning. However this second conception is regularly challenged and requires continuous energy to make the integration work. Of particular significance for this issue is the recognized scarcity of good professional development for teachers and in-school administrators, especially about IT integration, leadership, and student success (Galosy, Gillespie & Banilower, 2018). Also important is the issue of unequal and inequitable access to digital tools and resources within communities (e.g., due to socio-economic disparities) and across nations. In addition, there is a need to identify and develop further the digital tools' unique potential to foster and sustain leadership for learning by learners.

In general, we also recognized the challenge associated with structures (in schools and outside) that do not allow risk taking and do not recognize the learning potential of failures. This undermines our collective capacity to explore different models of activity systems. Three additional misalignments were identified. First, evaluation and assessment policies and

practices are generally not consistent with the desired outcomes of ambitious teaching. Second, in most formal educational systems the learning environment -the intricate interplay of space, time, participation structures, etc.- is not conducive to natural diverse learning patterns. This means that learners have limited opportunities to develop as leaders of learning; they are confined to a narrow band of pre-defined roles that may at best allow them to exercise agency for learning, to be active learners, but rarely to deliberately develop leadership for their own learning and for that of others around them. Third, the general lack of coherent connections between policy, research and teaching practices makes progress in this area very slow and incomplete.

Possible actions to overcome misalignment

To overcome the alignment problems identified above in a productive and sustainable way, our Working Group has identified the following key actions:

- Develop initiatives that will contribute concretely to developing a joint understanding of leadership, as it applies to situations of leading learning and innovative teaching integrating relevant digital tools at multiple levels (students, teachers, administrators, researchers, in schools and out of schools, in workplaces, etc.).
- Foster partnerships between researchers, practitioners, and policy makers (Bevan & Penuel, 2017; Coburn & Penuel, 2016) to work together around the targeted problems and issues identified above, especially to put into place teaching and learning practices (with relevant digital tools) that support the emergence of leadership for learning at all levels in schools, workplaces, and communities.

Key insights from other TWGs

The multiple interactions that this Working Group has had with other groups confirmed the need to –and the challenges of— creating a joint understanding of leadership, especially distributed leadership, in the multiple contexts of the learner as leader of learning. Our interactions also led us to the following key insights:

- IT can't be reduced only to "innovative teaching" given the social and corporate forces at play, and the fact that IT is not always innovative.
- Students can exercise leadership for learning for example by creating tutorials for other students, similar to Khan Academy, created by students for students.

Strategies and actions

Strategies and actions for policy makers

This Working Group would like to see policy makers engaged in developing an awareness and a joint understanding of leadership as it applies to situations of leading learning and innovative teaching. And policies should allocate resources in support of teacher preparation and professional development that integrate leadership for learning and digital resources. We also expect policy makers to want to promote the development and deployment of digital tools and resources that are accessible to all citizens.

Strategies and actions for practitioners

Practitioners, be it teachers, consultants, in-school administrators or a combination of those, would benefit from putting into place practices of peer-to-peer interactions, collaboration, and team work (Howard, Curwood, & McGraw, 2018; Lieberman & Pointer Mace, 2010; Nijland, van Amersfoort, Schreurs & de Laat, 2018; Prestridge & Main, 2018; Voogt et al, 2015) that provide them with opportunities to develop joint understandings of leadership for learning but also, and mostly, to engage in their own deliberate practice of becoming learners as leaders of learning (Allen, 2016; Fairman & Mackenzie, 2014).

Strategies and actions for researchers

Researchers, in partnership with technology providers and developers, can help develop further practices that integrate digital tools' unique potential to foster and sustain leadership for learning by learners: practices and tools that make learning visible and recognizable for oneself and for others (beyond grades), that allow differentiation and varied ways of engaging in learning and leading, etc. We also need more research on children's leadership, particularly *emergent leadership* in collaborative learning groups (Sun, Anderson, Perry & Lin, 2017).

Researchers have a role to play in mobilizing knowledge through such partnerships, so that emergent practices are co-designed and rapidly appropriated and that social innovations do not lag behind what can be developed in protected R&D environments.

Actions from the TWG

In addition to the actions above this Working Group is planning on promoting the outcomes of EduSummIT and other similar thinktanks and in particular advocating to policy makers and policy influencers the importance of developing leadership for learning beyond the traditional teaching models.

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Thematic Working Group 3
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Creativity for Teachers and Teaching

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Background

Creativity for Teachers and Teaching

Creativity has been highly touted as a central concept for 21st century thinking, teaching, and learning (Beghetto & Kauffman, 2007). It is widely noted in both academic literature and popular discourse as being essential to the types of thinking skills and approaches to the world that students will need for the present and future (Craft, 2010). Moreover, creativity is vital in teaching because students learn and adopt creative habits of mind and body when these are part of the environments, they learn in. There is a deep intersection between technology and creativity, and the potential of both to inform each other in learning settings. Yet the intersections between creativity and technology are complex and involve pedagogy, thinking skills, risk taking, failure, ideation, problem solving and more. Thematic working group 3 (TWG3) explores the intersections of these constructs and provide insight into how we can develop creativity in teaching and learning.

Developing Our Focus

Consideration of the intersections between creativity and technology is an expansive field of inquiry—requiring focus on an area which is feasible in scope and rich in practical relevance to education. Having reviewed the literature and building from previous EDUsummIT events, this year we focused our attention on risk taking and the notion of productive failure. At the EDUsummIT in 2015 the focus was on situating creativity within the field of educational technology and developing a systemic model (Henriksen, Mishra, & Fisser, 2016. In 2017 TWG3 considered how creativity is instantiated with technology across international contexts (Henriksen et al., 2018). For 2019, we have focused more specifically on risk taking and productive failure, which combine to shape how creativity emerges and develops in creative practices in teaching and learning.

Creativity is positioned as a vital part of education for digital futures, and for the technology-driven learning settings and work lives that students will inevitably face (Craft, 2010). However, the rhetoric about creativity often fails to account for the link between creativity, risk and failure. Risk and failure are essential in creative processes, and grappling with uncertainty in learning can lead to more reflexivity in a learning situation, and enhance the ability to manage ambiguity (Swanson & Collins, 2018). Risk taking and productive failure have always been noted as fundamental components of creativity (Glover, 1977); and a small but growing base of research literature also suggests that digital technologies and practices can both support or inhibit (for both teachers and learners) these aspects of creative practices (Manalo & Kapur, 2018), through opportunities for trialling and experimentation, as well as creating, sharing, and communicating in new ways.

To understand the importance of failure and risk taking in creative teaching, TWG3 has focused on critical questions around these issues, including:

1. How do teachers and learners develop the capacity to fail productively in classrooms? And how might technologies support this?
2. How do teachers and students develop skills for creative risk taking? And how might technologies support this?

At EDUsummIT 2019, we began the work of developing our group's thinking, creative products, outcomes and recommendations around these questions. The group did this through multiple rounds of collaborative and interactive discussions, hands-on making, design-based ideas and mini-workshop sessions. We aimed to refine our collective thinking by iterating on rounds of activities designed to elicit ideas about alignments and misalignments in the field, as well as recommendations for stakeholders. Our particular topic—while focused on teaching and learning—has also required us to consider these issues through the lens of multiple stakeholders in education, in terms of current alignment issues, challenges and opportunities for the future.

Alignment issues and challenges

Creative risk-taking and productive failure are essential in the conduct of creative processes, both in terms of iterations of failure that lead toward ultimate successand reflexivity about a given problem and its possibilities. Yet there are few existing guidelines, supports, tools or examples to help practitioners build risk-taking, productive failure and creativity into their teaching. Systemically, educational environments are often unsupportive of risk-taking and failure (Meyer & Turner, 2006). However, it is rare that good, original, creative work or ideas come together or succeed on the first try (Swanson & Collins, 2018). Therefore, teaching and learning settings need to integrate risk-taking and productive failure in teaching and learning in order for creativity to develop and flourish among both teachers and students.

Popular discourses about 21st century education denote creativity as a critical approach to thinking, acting, living and being in the world. At the same time, there is limited support and few guidelines for implementing the elements of creative risk-taking and productive failure (Clifford, 1991; Cropley, 2015). Many educational environments focus on practices that seem to run contrary to creative risk-taking and productive failure (e.g. high stakes testing, "curriculum crush", "teacher-proof" or scripted curricula, rewards/punishment-based

approaches to grading). While there is some variability in how this plays out across international contexts, and examples of systems that support creativity do exist (Henriksen et al., 2018), these are often exceptions. More commonly, as evidenced in our group's prior 2017 focus, most educational policy does not systemically support creativity—and, in fact, education systems often adopt a punitive stance toward risk taking and failure.

This systemic breakdown between educational rhetoric about creativity, and grounded policy and practice represents a significant misalignment and challenge in education internationally. Most of our group's work and thinking at EDUsummIT 2019 frequently returned to this overarching problem of misalignment, and to seeking ways to address this challenge across research, policy and practice.

Possible actions and areas to overcome misalignment

Despite this concern about misalignment, TWG3 was able to identify several areas of possible emerging new alignments between policy and practice.

New opportunities for creative risk taking and productive failure have arisen because of digital technology (e.g., Virtual Reality, Augmented Reality, robotics, coding). By virtue of the fact that such technologies are emerging, the implications for creativity, risk and productive failure are not fully clear as yet, but we suggest that there is a productive open space here to realign how we think about technology, pedagogy and content. By infusing these constantly evolving areas of technology, such as VR, AR coding, and robotics into open-ended project-based work, teachers can create more space for creative risk and failure. But in order to do so, these areas must receive attention in research, in policy and in curricula oriented to practice.

Also, new forms of organization of teaching and learning offer opportunities for creative risk taking. For instance, transdisciplinary/cross-curricula teaching, require teachers to discover new ways of working and new curriculum designs that in-of-themselves involve creative risk-taking behaviors. Furthermore, there has been increased recent interest in entrepreneurial thinking in education (Kirkley, 2017; Studdard et al., 2017), and this area naturally has an orientation to creative mindsets, including that of design and iterative development (Laurillard, 2018; Nash, 2018). By engaging more transdisciplinarity in curricula and classroom practices and allowing space for entrepreneurial thinking and focus in student work, schools and classrooms can support creative risk and failure in authentic ways.

These new emerging alignments should receive more attention broadly across educational research, policy and practice, as spaces to make connections to and allow for creative risk and failure—particularly in systems where disconnections have typically prevented risk-taking and failure.

Key insights from other TWGs

Other TWGs worked on ideas highly relevant to creativity. For instance, TGW4 focused on machine learning, and their work suggested that educational futures might be aligned to artificial intelligence (AI). There are significant possibilities in utilizing AI in managing risk-taking and productive failure, and this is a key area for future development around creativity

and educational technology. Our group also was able to connect with TWG9 whose work on advancing models of technology integration was particularly interesting—given that there are no existing models or theories that directly link and explain the enactment of creativity with technology in teaching and learning settings. The fact that there is also no agreed-upon mechanistic model of how creativity works is a challenge for creativity scholarship. This lack of consistent scholarly theory has hampered the inclusion of creativity in conversations around educational policy and practice. The work of TWG9 highlighted for our group the need to work toward model-building around creativity, technology and educational contexts. We were also inspired by TWG2's work on leadership, which brought forth group conversations about the fact that innovative leadership (with and through technology) is an inherently creative stance, as it requires a mindset toward finding new and better approaches to learning, technology and innovation.

Strategies and actions

Strategies and actions for policy makers

Currently, risk taking and failure have a negative connotation within curriculum policy frameworks (Harris & de Bruin, 2018; Henriksen, Creely, & Henderson, 2019). Therfore, we suggest that policy makers should positively reframe these concepts as part of reviewing the presentation of creative learning processes within documentation.

Along these lines, it is also important for policy makers to normalize creative risk-taking as a key competence of all stakeholders in education systems and workforce—in alignment with the interests of creative workforce development, and futures thinking

Finally, assessment is a key issue in strategizing around creativity, risk and failure in policy—so reframed policy should instigate space for alternative assessments and formative assessments that encourage and promote creative risk-taking, since the current high stakes testing environment seems antithetical to risk-taking.

Strategies and actions for practitioners

For practitioners, there are key strategies and action-recommendations for teachers, which should include having teachers:

a. Build classroom environments that are supportive of creative risk-taking and make allowances for productive failure.
b. Teach students strategies to "fail forward" or turn a failure into positive iterations that are an essential part of creative work.
c. Design activities which purposely integrate opportunities to try new ideas, fail, and then regroup and persist toward learning and creative outcomes.
d. Identify how technologies, as tools to think with, can allow students to trial and practice ideas and iterations of creative work.
e. Model processes of creative risk taking and productive failure in their own practices.

Local education leaders are also central to what happens in classrooms, and they should promote creativity by valuing creative risk taking and productive failure in teachers (i.e reward or recognition structures aligned with creative risks).

In broadening the stakeholders, we suggest that teachers and administrators should recognize the role of each learners' family and peers in their capacity to engage in creative risk-taking. Communication between school and home should emphasize creative risk and potential failure for students' preparation for work and life.

Finally, teacher educators, both pre-service and in-service, must integrate conceptual and practical learning around creative risk-taking and productive failure into coursework and field experiences.

Strategies and actions for researchers

There is a lack of research around creative risk taking and productive failure in the field of education. Therefore, it is strategically important that more empirical studies are conducted to reveal how creative risk taking and productive failure enhance learning, and how they are best supported in educational settings. In particular, risk-taking and failure are grounded in context, so rich, school-based studies (including longitudinal work) to enhance understanding of these concepts within and across varied contexts.

The nature of creativity for learning, including the role of risk-taking and process of productive failure, continues to be misunderstood in educational policy and practice. This suggests that creativity researchers need to better understand why this misalignment exists, how it can be realigned in their own work, and then disseminated effectively to the field.

There is also little research relating to the role that technology can play in supporting (and constraining) creative risk taking and productive failure. Researchers might begin by connecting with existing relevant research areas such as the personal attributes of resilience, persistence and personal skills with risk-taking and a willingness to enage with failure.

Finally, assessment regimes, including the high stakes testing in most education systems, have been identified as a critical impediment to developing cultures of creative risk taking. Creativity researchers should seek to integrate their work into existing conversations around assessment. Allowances for trialing, failure and iteration are needed within assessment structures.

Actions from the TWG

Most of the members of TWG3 currently have connection to research and/or practice at an individual level, but we believe that through our collective work, we can bring a fresh perspective to scholarly research and promote change in policy and practice. Some actions which are already planned in the immediate future include:

- Preparing and disseminating to our networks (which include a mix of researchers, policy makers and practitioners) all of our EDUsummIT 2019 products and outcomes (including, but not limited to, this ebook chapter, our action plan, our group two-page summer, and our discussion paper).
- Writing a paper to be submitted to the SITE 2020 Conference Creativity SIG (to be submitted for the first call) on the relationship between creativity, risk and failure and technology in teacher practices—focusing on both the challenges and possibilities.

- Devising a proposal for a symposium at the SITE 2020 Conference Creativity SIG (to be submitted for the second call). In this symposium each presenter from our group (and possibly a couple of other relevant scholars invited from our networks) will share aspects of both our EDUsummIT 2019 groupwork and their institution-based work on the relationship between creativity, risk/failure, and technology.
- Offering a group-level set of case studies on creativity, risk/failure, and technology in education, in which each member presents a written case example of these issues in an instance of grounded teaching and learning.
- Submitting a paper on our work for the EDUsummIT special issue of the *Canadian Journal of Learning Technology*.
- Submitting a paper on our work for the EDUsummIT special issue of *Educational Technology Research and Development*.

Other products and outcomes that link policy, practice, and research around creativity, risk/failure and technology in education will also emerge from our groupwork. Our group has a strong collaborative working relationship, and there are strong alignments between our interests and goals. This is likely to for produce multiple outcomes in coming years as we disseminate our work to the field.

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Thematic Working Group 4
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State of the Art in Thinking About Machine Learning: Implications for Education

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Introduction and background

This paper was born from a meeting of experts in Quebec, Canada in October 2019. Through a pre-meeting process of collaborative writing, intensive literature review and critical reflection, the meeting was able to synthesize and analyze previous research. In so doing, the group has generated a new and creative approach to machine learning in education. The paper summarizes the expert group findings, and provides strategies and actions for policymakers, practitioners, students, researchers, and/or developers of machine learning systems in education.

New partnerships between humans and machines are changing learning interactions, and both the scope and range of learning opportunities. Artificial intelligence applications, such as language and voice recognition and intelligent personal learning environments, are changing the ways we can learn. Decisions are being made based on the new affordances that machine learning offers, resulting in new challenges for learners, teachers, researchers and administrators. Machine learning, simply stated, is a way for computers to learn from data - for example detecting patterns, classifying data and making predictions. Deep learning, a relatively recent development within machine learning, often increases the complexity and reduces the transparency of the machine learning processes, owing to the multi-layered neural networks on which it is generally based. The increasing prevalence of machine learning raises questions such as: who will be teaching whom, who will be leading whom and what roles will be available to humans and machines?

Examples of machine learning (ML) that many people will be familiar with are self-driving cars, online recommendations from Amazon or Netflix, voice controlled digital assistants on mobile phones and spam filters. More broadly, applications of machine learning are widespread and

increasingly infused across most areas of human endeavor, including agriculture, the energy industry, e-commerce, fault detection and diagnosis across most types of machinery and healthcare. Likewise, in education, machine learning is becoming more widespread and has been used, for example, for improving curriculum design (Ball et al. 2019), automated assessment systems (e.g, see Whitelock and Bektik 2018 for a review), learning analytics and formative assessment (Ifenthaler, Greiff, and Gibson 2018), predicting students' grades (Livieris et al. 2019), recommending higher education courses to students (Obeid et al. 2018), identifying students at risk of dropping out of courses (Gray and Perkins 2019) and personalized learning with student modelling for adaptive learning and intelligent tutoring systems (Conati, Porayska-Pomsta, and Mavrikis 2018). A recent policy foresight report by the Joint Research Centre (JRC), the European Commission's science and knowledge service, suggests that artificial intelligence (AI) powered by machine learning will change learning, teaching and education rapidly in future, creating high pressure to transform educational practices, institutions and policies (Tuomi 2018).

In this paper we examine how machine learning will have implications both for how people learn in the future and for what learners and teachers need to know about machine learning. Furthermore, we consider the implications for education policy, practice and research. We start by examining issues and challenges that are being generated as machine learning (ML) pervades education. Most of the issues are interrelated and are dependent on the major issue of understanding the nature of machine learning as it becomes ubiquitous in society generally as well as impacting education. We then specify policy, practice and research recommendations for educational contexts.

Issues and challenges for machine learning in education

Understanding machine learning concepts

In order to optimize student learning there is a need to identify machine learning concepts that should be understood by students and teachers. These needs include those of students aiming for careers requiring computer science understanding but also for all students for whom such understanding is important to prepare for lifelong learning and to take their places as informed citizens. Understanding these needs requires first characterizing current ideas and technologies in the field of machine learning and then to consider how these technologies impact education and whether and how the associated concepts need to be made accessible to students. There is consensus that machine learning is a subset of artificial intelligence, and that deep learning is a subset of machine learning (see Figure 1).

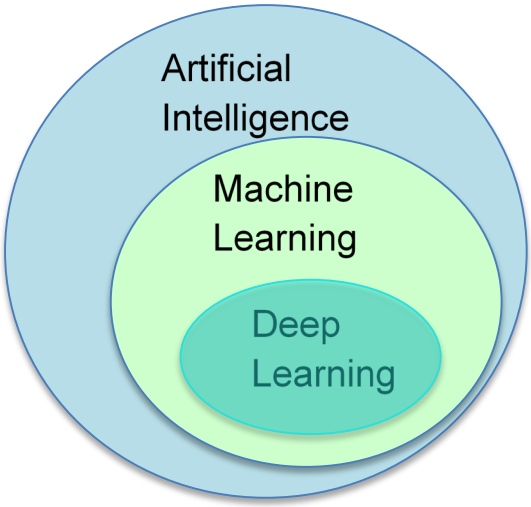

Figure 1 Relationships between key terms

The origin of the term 'artificial intelligence' is attributed to a conference at Dartmouth College (USA) in 1956 and refers to studies where computers behave like humans. Following more than 50 years of research, and abundant articles, artificial intelligence is still not clearly defined and there are diverse views on its potential and risks (Kaplan and Haenlein 2019). An early ubiquitous definition of machine learning which is often quoted and emphasizes outcomes is:

> *"Learning denotes changes in the system that are adaptive in the sense that they enable the system to do the same task or tasks drawn from the same population more efficiently and more effectively the next time." (Simon 1983, P. 28).*

But as Wang and Tao (Wang and Tao 2008) explain, such a definition is inadequate for computer scientists who are focusing on designing algorithms and analyzing problems that can be solved by machine learning. In education also, we need more functional definitions that characterize the machine learning processes as well as the outcomes. While, just like in human cognition, perceptual capabilities and access to data are also necessary for artificial intelligence, it is the machine learning processes that determine not only the nature of the outcomes and judgements that are made by the system but also our access to how such judgements were made. Wang and Tao's definition emphasizes the practicalities of implementing machine learning: developing a model that is true to the real-world problem being solved, and generating a representative dataset and using algorithms with statistical reliability:

> *"the process (algorithm) of estimating a model that's true to the real-world problem with a certain probability from a data set (or sample) generated by finite observations in a noisy environment." (Wang and Tao 2008 p. 49).*

Thus, the nature of the machine learning in any particular system depends not only on the algorithms with which it has been originally programmed and the architecture specified, but also on the design decisions of the original engineers in terms of the values of learning rate parameters, the initial training regime, the choice of dataset, the context in which it is learning and subsequent upgrades to the system (Rahwan et al. 2019). Machine learning can be classified according to the inputs that it learns from as:

1. supervised learning where both training data and correct answers are supplied;
2. unsupervised learning where machines learn from a dataset on their own;
3. semi-supervised learning where the training set has some missing data and the algorithms are still able to learn from the incomplete data; and
4. reinforcement learning based on feedback from the environment.

A major focus for current research and development in machine learning is “deep learning” (DL) or deep neural networks (DNN). LeCun, Bengio & Hinton (2015) provide a useful characterization of deep learning that primarily uses neural networks:

> *“Deep learning allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction….. Deep learning discovers intricate structure in large data sets by using the back-propagation algorithm to indicate how a machine should change its internal parameters that are used to compute the representation in each layer from the representation in the previous layer.” LeCun, Bengio & Hinton (2015, p.436)*

Deep learning is now widely used in speech recognition and computer vision and is expected to make a large contribution in many other fields in the near future (Sze et al. 2017). Back-propagation is a process that takes place during the training phase of a neural network. As each element in a data set is processed through the neural network, the resulting prediction is compared with the actual known target value. Once the difference between the prediction and actual value is determined, the weights (strength) of links in the neural network are adjusted in a "backwards" direction, between adjacent layers, to minimize error between the prediction and target value. The complexity of multilayered neural networks as well as the probabilistic nature of the models means that typically deep learning operates as a “black box” such that the basis of outcome decisions is not accessible, so decisions may have limited or no explainability. Using deep learning, significant progress has been made for handling bimodal data and dealing with very large datasets, but major challenges remain for dealing with high velocity data, multimodal data sources (Baltrušaitis, Ahuja, and Morency 2019) and low-quality datasets. Furthermore, whereas humans are very capable of coping with the typically continuous streams of data that we receive and can integrate new knowledge into existing knowledge, this lifelong learning remains very challenging for the deep learning algorithms currently available (Parisi et al. 2019). Typically, models are “trained” with static datasets and incorporating new data requires retraining which often results in catastrophic forgetting or catastrophic interference with existing knowledge (Parisi, Kemker et al. 2019).

Examples of how deep learning is already becoming important in educational contexts include assistive tutors, such as *Amira* (https://www.amiralearning.com/) and *Duolingo* (https://www.duolingo.com/) that aspire to increase student progress through individualized support and instantaneous feedback. *Amira* is a reading assistant (chat bot), for K-3 students that listens, assesses and coaches to accelerate reading mastery using deep learning to determine its interventions. *Duolingo* is an application for learning a foreign language that adapts to the user's capabilities, using users’ data and deep learning to predict, for example, whether the user will remember a word. Data from 300 million users also enables the Duolingo system to use deep learning to discover new insights about the nature of language and learning.

Need to identify concepts and practices for students by the end of compulsory school (12th) and their teachers

By shifting the question from "how to program computers" to "how to allow them to program themselves," (Mitchell 2006), machine learning is reshaping our view of computer science and thus computer science education. Many countries have recently redeveloped their computer science curricula to respond to the need for a better understanding of computer science among citizens as well as the need for more computer scientists (Webb et al. 2018), but curricula will need to adapt further in order to address the changing emphasis in computer science brought about by machine learning. The rapid developments in machine learning and the future expectations of widespread use of machine learning-based applications throughout society, mean there is a need for all students to develop some basic literacies relevant to machine learning by the end of compulsory education. These literacies are needed for everyone to be able to understand the nature of the machine learning processes that may be supporting their own learning, as well as to act as responsible citizens in contemplating the ethical issues that machine learning raises.

New literacies for machine learning

Currently, there is a lack of clarity around the literacies needed to develop understanding of machine learning in education. As outlined above, machine learning uses models, especially stochastic models, a wide range of algorithms, inferential statistics, big data and artificial neural networks. In any particular implementation these methods are combined in various ways to provide an artificial intelligence-based system that may also incorporate many other elements. Thus, in order to understand the machine learning that drives an application, one needs to understand: statistics; inference from statistics; probability theory; data architecture, structures and representation; management of big datasets as well as the nature of algorithms. Therefore data, algorithm, modelling and machine learning literacies need to be taught.

Ethical issues raised by machine learning

When algorithms are used to draw conclusions based on data using inferential statistics and/or machine learning it raises ethical concerns for which Mittelstadt et al. (2016) developed a conceptual map (see Figure 2). The map is proposed as an organizing structure to identify and structure discussions of ethical issues. There are three main epistemic concerns. First, algorithms can produce inconclusive evidence because their methods can identify correlation but not causation. Secondly, the "black box" problem of explainability, discussed earlier, gives rise to inscrutable evidence and reasoning processes. Thirdly, conclusions can only be as reliable (but also as neutral) as the data they are based on, thus providing possibilities for misguided evidence. Even if the reasoning processes can be made accessible, in order to examine the evidence, users need to know the provenance and quality of data used for training, testing and validation, and how each of the many data-points used by a machine-learning algorithm contribute to the conclusion it generates. In addition to these three epistemic concerns, as indicated in Figure 2, there are normative concerns because actions driven by algorithms are assessed according to ethical criteria and social principles which evaluate fairness and discrimination. For example, even if based on conclusive, scrutable and well-founded evidence, an action driven by an algorithm may be regarded as discriminatory; it may be discriminatory solely from its effect on a class of people that is protected in that particular social context. Finally, all of these concerns feed into the overarching issue of traceability which is important for identifying responsibility when

problems occur. Traceability also affects transparency, explainability and accountability as discussed later.

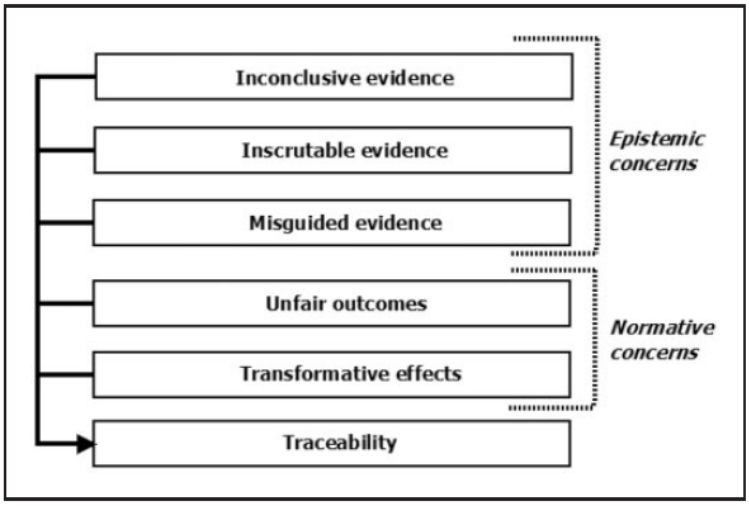

Figure 2 Conceptual map of six types of ethical concerns raised by algorithms (Mittelstadt et al. 2016).

Transparency and explainability

As explained earlier, machines making decisions and/or predictions can be perceived as a "black box" because deep learning algorithms and models can be very complex and inscrutable thus inhibiting traceability of reasoning processes. In many educational situations, there is a need for transparency of the reasoning processes as well as the data used so that decisions and conclusions made by machines can be explained. This transparency is essential to minimize bias and ensure that decision-making based on machine learning is fair, interpretable and accessible for all. There could be considerable legal obstacles to its adoption if the operational characteristics of a machine learning system cannot be explained. The European General Data Protection Regulation applies nearly worldwide, since it has implications for all European trading partners through its extraterritorial applicability. There is debate about the implied 'right to explanation' of algorithmic decisions in the EU General Data protection Regulation (GDPR):

> *"The controller shall … provide the data subject with the following further information necessary to ensure fair and transparent processing: … f) the existence of automated decision-making … and meaningful information about the logic involved, as well as the significance and the envisaged consequences of such processing for the data subject." (EU GDPR Article 13, 2018).*

Accountability

Harm caused by algorithmic activity can be hard to detect and find its cause. Furthermore, it is rarely straightforward to trace who should be held responsible for any such harm caused owing to the multiple actors involved in the design and development of the system. Creators of machine learning systems/models should be held accountable for any issues of bias and transparency.

Need for a code of conduct

Because biases can be built into machine learning systems (intentionally and/or unintentionally) there is a need for a code of conduct to guide the development of machine

learning for education in publicly accountable ways. Such a code would need to provide practical guidance for addressing issues of responsibility, explainability, fairness, transparency and accuracy both at the design stage and when the system is in use.

Privacy

Privacy has become an increasingly important and complex issue as a result of developments in technology. Machine learning adds to these concerns because machines will be able to derive meaning from words and phrases, not simply translate words. This means that colloquialisms, phrases that combines words in ways to change meaning and words in context will be better understood, which has significant implications for machine learning applications. This means personal privacy and equity will become increasingly important as people struggle with decisions between the convenience that machine learning provides and personal privacy that is given up when taking advantage of these conveniences.

Trust (students)

If humans and machines are to work as true partners in solving problems, a greater degree of trust needs to be developed in the ways machines are solving problems. This is difficult to do when machines using deep learning are not yet able to describe how they go about coming to a conclusion or predicting an outcome. For example, through machine learning we know that telemetry devices attached to newborns in neonatal units can predict which infants will develop an infection 24 hours before symptoms present themselves (Hu, Lee, and Tan 2018). Medical professionals are put in a position to have to trust these predictions without fully understanding the causal relationship. Without this deeper understanding of how machine learning addresses and solves a problem, humans are not likely to be able to fully trust machines as partners. It is difficult to establish trust with machines if they cannot explain themselves, and therefore humans cannot understand how they come to conclusions.

Understanding human-machine power relationships

As humans and machines become partners in learning and problem solving, there is a need to explore and better understand human-machine power dynamics.

Possible actions

Considering these challenges, there is a need to better understand human requirements for communication from machine learning systems. Research into student modelling, i.e. computer modelling of individual learners, with the focus on “Open Learner Modelling” in which student models are accessible with varying levels of interactivity, has started to determine what information to reveal to the user, how and why and how closely the presentation should represent the machine learning and data models (Conati, Porayska-Pomsta, and Mavrikis 2018). These key considerations are: 1) why the Open Learner Model is being built; 2) which aspects of the model are made available to the user; 3) how is the model accessed; 4) who has access to the model.

Fundamentally, as machines learn, they are not yet able to communicate in human-understandable terms, nor can they self-assess task competency and strategy. Being able to do so is essential if we want to engage with machines in a more accessible and intuitive way and if we are to work together seamlessly with machines as trusted, collaborative partners.

To address these types of challenges and to build competency-based trusted machine learning systems DARPA (the U.S. Defense Advanced Research Projects Agency) is developing Competency-Aware Machine Learning (CAML) systems. Such an autonomous system would be able to "self-assess its task competency and strategy, and express both in a human-understandable form, for a given task under given conditions" (Special Notice DARPA (SN) DARPA-SN-19-26 p.1).

Approaches to teaching about machine learning are being developed at all levels of education and a range of materials are available online to support the learning and teaching of machine learning. *Machine learning for kids* is a free online application based on the Scratch programming language that introduces machine learning by providing hands-on experiences for training machine learning systems and building things with them (https://machinelearningforkids.co.uk/). *Calypso* for Cozmo is a simple tile-based user interface for the Cozmo robot that incorporates multiple artificial intelligence technologies to learn more about robot logic and behavior (https://Calypso.software). *Cognimates* is platform based on Scratch for building games, programming robots & training artificial intelligence models (http://cognimates.me/home/). *Teachable Machine* is a free online application to start exploring how machine learning works by using a webcam as an input to train a machine learning model and running neural nets (https://teachablemachine.withgoogle.com/). *TensorFlow Playground* is an open-source interactive visualization of neural networks. It contains a tiny neural network library that meets the demands of this educational visualization (https://playground.tensorflow.org). An initiative for the teaching of deep learning was launched by Korbit, a Montreal company. The course, free and open to all, is 4 weeks long and contains lectures and interactive exercises (https://www.korbit.ai/machinelearning). A deep learning tutor guides students through the course, so this is an online course on machine learning taught by a machine learning tutor. It is an initiative that helps to democratize the understanding of artificial intelligence and deep learning. These materials may help to support teachers and learners in exploring machine learning but we recommend a number of interrelated strategies for developing the understanding and skills needed for teachers and learners to make informed use of machine learning and contribute to discussions about the future of machine learning.

Recommended strategies from the thematic working group

At the conclusion of the meeting, the group formulated a series of recommended strategies and actions for people using machine learning in education. These recommendations are addressed to student learners, policy makers, practitioners (often teachers), researchers and machine learning software developers as appropriate:

- Reform curricula to ensure all students develop a strong background in machine learning. In order to develop their conceptual understanding of algorithms, models and how machine learning works, students must have opportunities to use and apply machine learning and to create their own examples. As a powerful tool that may not be used to its full potential, there is a need for students to understand how machine learning can be used to identify and solve real-world problems (policymakers, practitioners, researchers, and/or developers).

- Identify and define emerging literacies related to machine learning, algorithm, data/big data, and modeling (practitioners and/or researchers).
- Report on the status of policy and practice of machine learning in education across various countries around the world (researchers).
- Update policies and practices to keep pace with developments in the field (policymakers, practitioners and researchers).
- Develop a Code of Conduct for machine learning in education for users and developers (policymakers, researchers and learners)
- Provide machine learning professional development and resources for teachers, educational leaders and other key stakeholders to support education reform (policymakers, practitioners, researchers, and/or developers).
- Support educators and learners in conducting risk analysis in the use of machine learning in education (policymakers, learners, and/or developers).

Recommended actions from the thematic working group

1. Present the outcomes and recommendations from EDUsummIT at key conferences and meetings including International Federation of Information Processing Open Conference on Computers in Education (OCCE 2020), Edmedia etc.
2. Write an academic journal article for the special issue from EDUsummIT.
3. Write a professional journal article aimed at practitioners.

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Thematic Working Group 5
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Safe and Responsible Internet Use in a Connected World: Teaching Critical Thinking and Accountability to Promote Cyber-Wellness

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Background

Cyber-wellness (CW) involves an understanding of online behavior and keen awareness of how to inform and protect oneself in cyberspace. The focus of CW is on helping students to become responsible digital learners and citizens. Given the broad reach of the World Wide Web—and access to children which that provides—information and media literacy, and awareness of the potential dangers inherent in participating in that environment, has become increasingly important. Ensuring that young people develop a deep understanding of the importance of the need to take responsibility for their online safety (including how their online behavior and activity affects both oneself and others) and developing skills to critically assess online information, will be essential for improving CW moving forward.

Digital equity, digital citizenship and CW need to be considered within the larger frame of a global socio-critical perspective or within the context of culture, politics and civil society (Ntebutse and Collins, 2018), and any conversation addressing these constructs needs to be situated within a geopolitical–sociological frame.

CW may be defined as "the positive well-being of Internet users and a healthy cyber-culture for the Internet community" (Putnam & Pulcher, 2007, p. 73). There is a need for freedom to socialize virtually, to use e-learning platforms to obtain mental and physical health information and to participate freely in a political process. It also requires a degree of cyber-etiquette, responsibility and civility in the virtual public sphere. Searson et al. (2015) define global or digital citizenship as follows: "a person who develops the skills and knowledge to effectively use the Internet and other digital technology especially in order to participate

responsibly in social and civic activities." One challenge may well be in reaching consensus on a definition of “effectively” and “responsible.”

The focus for Thematic Working Group Five was Safe and Responsible Internet Use in a Connected World: Teaching Critical Thinking and Accountability to Promote Cyber-wellness. We built on the efforts of TWG8: Digital Citizenship and Cyberwellness from the 2015 EDUsummIT. The present work was guided by the following questions:

1. What information can be trusted; how do we recognize and deal with fake news; what information should/should not be posted online; how do we promote information literacy and media literacy?

Making a judgement about whether or not information obtained online is reliable is an advanced information literacy skill which most young people do not fully possess (Bartlett & Miller, 2011; Larson et al., 2018). Moreover, such skills are also more prevalent in countries where technology use is more developed and in students from higher socio-economic backgrounds, and those having more technology using experience, raising digital divide concerns (Ainley, 2018). Specific challenges to information literacy include fake news, echo chambers (accessing information that reinforces views rather than challenging it) and political manipulation (using online data to target messages at population sub-groups) (Kimmons & Bellikov, 2018; Law, Chow, & King, 2018). Teachers report that this can lead to students presenting work based on misinformation and propaganda (Bartlett & Miller, 2011).

The development of young people’s information and media literacy skills, including critical thinking, is best approached in school contexts (Bartlett & Miller, 2011; Majid et al., 2016; Kimmons & Belikov, 2018). However, this requires all teachers to have appropriate knowledge of these skills and how best to teach them (Majid et al., 2016; Passey et al., 2018). Moreover, evidence suggests that even when policies mandate this approach, as is the case in Singapore, there can still be huge variation in students’ experiences and skill levels across different schools (Majid et al., 2016).

2. How we can make sure that children and youngsters feel safe in the digital world and that they can take such responsibility for their own use of technologies; how young people and others can recognize and deal with cyberbullying, predators, phishing and potential identity theft?

Threats to CW can occur when the child is the agent--purposefully or inadvertantly accessing or posting inappropriate information (see Figure 1), or when others target children (see Figure 2). Livingstone et al. (2012) identified risks encountered by children including receiving sexual messages, online contact with strangers, face-to-face meetings with such strangers, harmful content and misuse of personal data. Cyberbullying and suicide related to such bullying also affect children awareness (Mark & Ratliffe, 2011; Cohen-Almagor, 2018). Lack of awareness of these dangers is a potential for online or in-app purchases” to “experiencing inappropriate content” or “engaging in contact with unknown people”. On the other hand, the participants aged 8 to 18 in Zilka’s study (2017), showed a “medium-high” level of awareness of internet dangers.

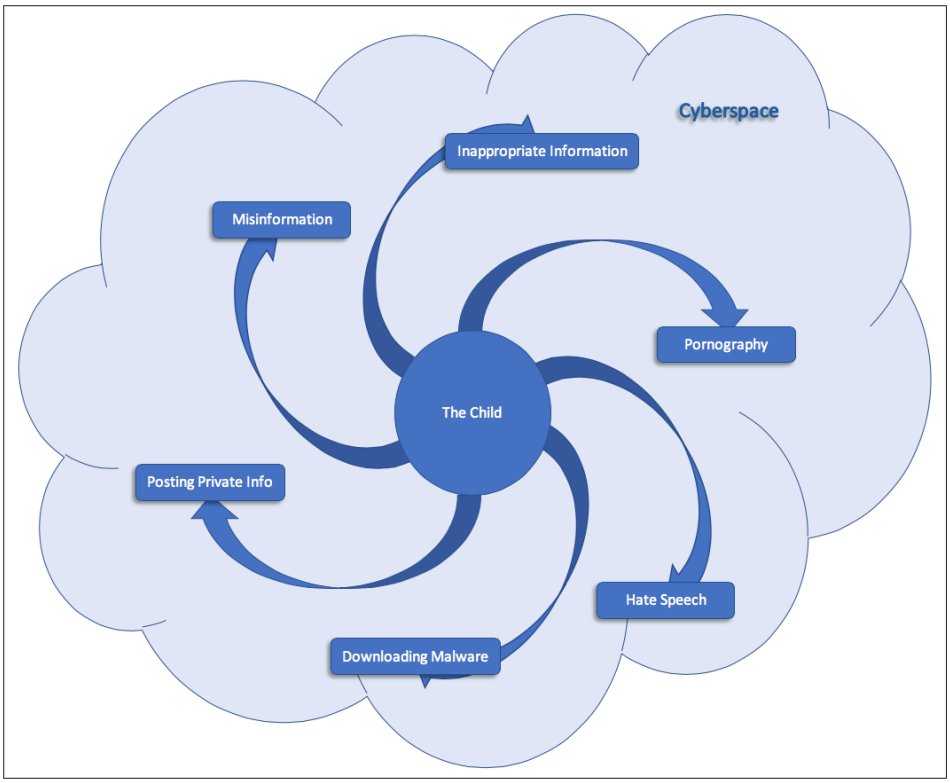

Figure 1 Threats to child CyberWellness as agent.

This figure illustrates some of the dangers that a child may encounter in CyberSpace.

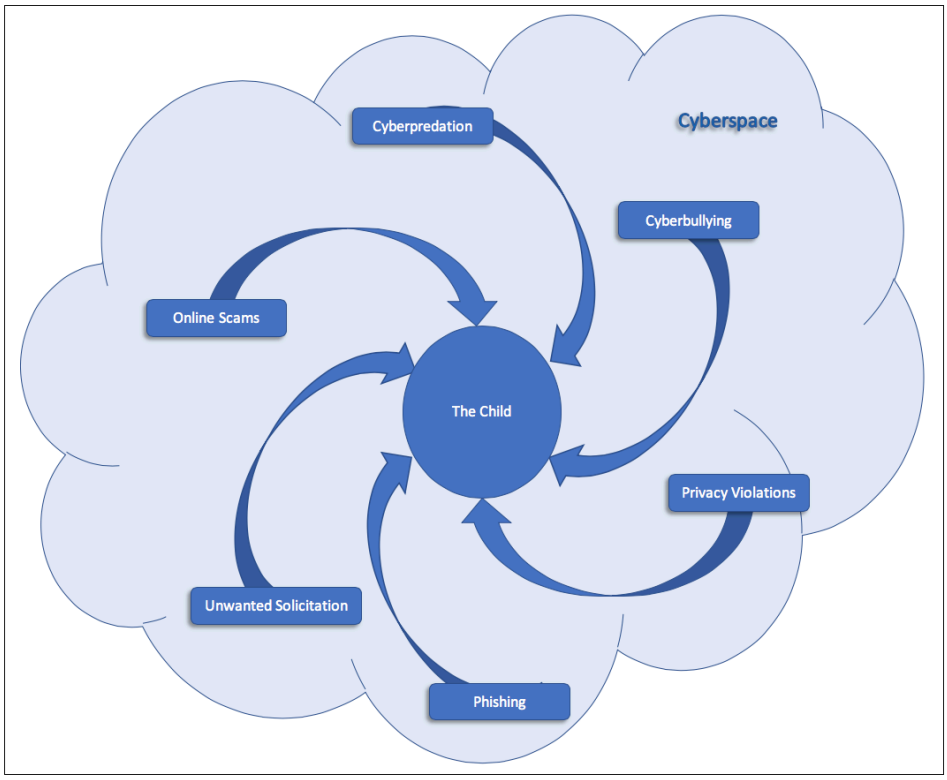

Figure 2 Threats to child CyberWellness as target.

This figure illustrates some of the dangers that a child may encounter from CyberSpace.

The "anxiety" caused by widespread media exposure to online dangers often leads governments to adopt hasty solutions that end up trying to "control" young children rather than to guide them (Facer, 2012). Such attitudes may lead to practices of "over-blocking" through internet filters, implying a culture that is reactive rather than proactive, fearful rather than confident (Hope, 2008). According to Davies (2011) this kind of pessimistic attitude towards technology is not only prevalent among teachers and parents but also among the children themselves. Further, although we might choose to understand this as an issue of adults over-parenting their children, the situation may be more complex.

3. How can public awareness of online children's protection and cyber-wellness (digital citizenship notion) be improved?

There is increasing recognition of the need for child-CW in our rapidly changing global society given the risks inherent in allowing children to access and engage with the Internet. To address this issue, numerous government and private agencies have provided online informational resources to help raise awareness of threats and concerns, and present strategies to help children avoid the potential hazards. For example, excellent informational resources can be found at https://www.moe.gov.sg/education/programmes/social-and-emotional-learning/cyber-wellness, which was developed in Singapore, and http://mediasmarts.ca from California. Additional resources for addressing global CyberWellness efforts are available through the United Nations website on *Cybercrime: Protecting children from online abuse and exploitation*, and UNESCO's multimedia educational materials (see https://en.unesco.org/themes/media-and-information-literacy). Private organizations have also contributed to the materials and resources available to help raise parent and child awareness.

4. What kind of policies (at macro, meso, micro level) should be developed in order to promote CW?

With regard to macro-level policy, Searson et al. (2011) raised a truly salient point regarding the degree to which the development of CW and cyber-citizenship is limited by national/state identity and other structural factors. This begs the question of whether CW, as a component of digital citizenship, should be subsumed under the umbrella of civil rights or human rights. Further, does the constituent power to develop substantive policies addressing CW and cyber-citizenship lie within the domain of a new international cosmopolitan order—or reside within sovereign location-bounded states.

At the meso level, each of us develops a personal understanding of the world and our place within it. Given the multitude of social and cultural contexts around the world, there is no common standard for appropriate and rational behavior in the virtual public sphere. Further, the open nature of the World Wide Web (WWW) does not allow for control over the information that is posted, so disparate world views are bound to come up against each other. The question is how do we move beyond this relativistic frame to a common and agreed upon global ethos of CW and digital citizenship? Since we cannot control information on the WWW the development of globally acceptable CW norms will need to focus on the user, with self-restraint replacing external constraints. This leads us to a view of CW that is teachable and navigates the channel between relativism and the human right to seek-receive-impart information in a self-monitored and civil virtual public sphere.

There is considerable literature that advises us on how and what to teach students to develop cyberwellness and a healthy sense of digital citizenship (see Law, et al., 2018; Cooney, Nugent & Howard, 2018; Hui & Campbell, 2018). At the micro level, our task is to educate students so that they can safely and equitably participate in online communities, and that this participation is viewed as essential to a student's development in our global society.

5. What activities and practices can promote and develop young people's CW? How could and should school curricula be changed?

The limited research that has been conducted in this area has addressed issues like growing students' global digital citizenship through online international communication. For example, Larson et al. (2018) have found the sixth graders of USA and Ireland heightened levels of global awareness and diverse perspectives through their activities of online literature circle. Hutson et al. (2018) conducted a systematic review and found decreasing effects on cyberbullying and cyber-victimization were shown for nine and ten prevention programs out of seventeen, respectively. Matsuda et al. (2012) have developed three-dimensional virtual reality materials which provided students with analytical problems and feedback according to their ability to understand cyber-ethical codes and shown the effects of use of the materials. However, it seems that such practices are unexpectedly infrequent, given the large volume of cutting-edge technologies in society.

Alignment issues and challenges

To promote and develop CW we need to look beyond schooling, to consider informal as well as formal learning contexts. We need to be aware of the multiple stakeholders involved, from teachers and parents to community members and commercial technology providers. A key aim should be to instill a healthy scepticism in our youth and ensure that they are proactive in protecting themselves. Young people need to be empowered through the development of resilient attitudes and skills, through experience, risk-taking, and failure. Thus, protecting children from the dangers of the internet by filtering information will not allow them to develop the skills they will need to protect themselves.

Issues

- We need to more thoroughly unpack cyber-wellness and the elements/characteristics of cyber-wellness; and link to wellness – to solidify and contextualise our understanding.
- Developments in technology are presenting threats to maintaining cyber-wellness (e.g. increasing surveillance, managing students' personal behavior, data and learning analytics).
- We need to convince others of the importance/value of the idea of overall wellness.
- We need diverse, flexible and sustainable practices to support the development of cyberwellness across learning environments within social contexts in a civil society (cultures, socio-economic backgrounds, ideologies, etc.).

Misalignments

A. The focus is on cyber-wellness when it should be focused on wellness more broadly. Cyberwellness is a component of wellness.

B. Rather than being focused on the cyber-well-being of the learner, the role of technology in education systems is driven by outside forces (commercial interests, government entities, political interests, propaganda, etc.).
C. The focus tends to be on setting limits and regulation, rather than focusing on a strength-based approach that encompasses balanced skill-building towards empathy, compassion, self-regulation, self-awareness, community awareness and support structures.
D. We are lacking guidance, training, and tools for practitioners that ground theory and practice. Current curricula do not effectively integrate well-being.

Possible actions to overcome misalignment

We view these as emerging trends that need to be accounted for rather than solutions:

- The heightened importance of the ability to comprehend the validity of information.
- Artificial intelligence is emerging as a new digital approach in education.
- Stakeholders have access to much more data than ever before.

Strategies and actions

It will require concerted and collaborative effort from policymakers, researchers and practitioners to overcome these misalignments. To accomplish this we have identified the following strategies to address the misalignments identified above.

Strategies:

- Create a balance between learning opportunities and use of protocols in cyber-wellness education [A] [D].
- Have educators take more responsibility in developing these practices [B].
- Create an understanding of the mutual relationship between technology and humans; we are shaping the technologies that we use and that the technologies that we use are shaping us [C].
- Establish an ongoing cycle of evaluation of the technologies that we use [A] [B].

Actions:

- Develop consensus on a concise definition of wellness and cyber-wellness (social, psychological, physical and cognitive) [A] [D].
- Increase awareness of the fact that cyber-wellness is part of overall wellness [A].
- Promote self-awareness of how we learn and are influenced by technology [B][C][D].
- Increase involvement of young people in designing and conducting research and informing policy and practice [A] [C] [D].
- Develop and integrate communities:
- to provide peer-to-peer support in response to issues that arise [C].
- of stakeholders for discussing and determining the proper use of technology [C].
- Provide guidelines so that stakeholders can make informed choices relating to cyber-wellness [B].
- Encourage stakeholders to integrate wellness across curricula [C][D].

Actions from the TWG

We plan to take the following actions:

- Present the themes and challenges identified by TWG5 at the Open Conference on Computers in Education, Mumbai, India, January 6-8, 2020.
- Publish brief companion pieces in the Ed Tech magazine TWG5 member Audrey Miller edits (L'École branchée: https://ecolebranchee.com/author/audrey/).
- Submit a manuscript to the CJLT/RCAT special issue.

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Thematic Working Group 6
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Putting Learning Back into Learning Analytics: Optimizing Learning Through Analyzing the Data

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Background

Learning analytics have been defined as the use of static and dynamic information about learners and learning environments, assessing, eliciting and analyzing it, for real-time modelling, prediction and optimization of learning processes, learning environments, as well as educational decision-making (Ifenthaler, 2015). To target the outcomes of data systems is a new challenge for computer scientists and engineers as well as educators. In addition, a large number of stakeholders draw on learning analytics, such as learners, teachers/educators, learning/instructional designers, institutional leaders, scientists, and public as well as private providers. For instance, learning analytics of student data sets can be used for formative and summative assessments, but issues related to privacy and usability are growing concerns. For example, with large data sets available to teachers and learners, who owns these data, which data are available, and which are private? Furthermore, who analyses these data and who is the data analyzed for? What can teachers do with all these data and what feedback and monitoring of learning might students expect from learning analytics? How can fair uses of techno-led or enabled assessment be ensured and what are the risks associated with data use for promoting students' achievements? This eBook report shares the results of an international discussion of these issues, which identified how learning analytics may influence policy and teaching practices.

The members of thematic working group 6 (TWG6), representing eight countries, spent six months in 2019 collecting, reviewing and synthesizing evidence from research publications, reports, correspondences, and practitioner conversations around learning analytics. The sources ranged from university research projects to articles based on practice and usage of learning analytics dashboards and applications. This background work enabled TWG6 to identify current and potential issues around the use of learning analytics. TWG6 report suggests strategies and actions, and recommendations for policy makers (PM), researchers (R) and practitioners (PR) to attempt to overcome the potential issues we foresee.

Alignment issues and challenges

In this section, five positions that highlight alignment issues and challenges due to a variety of problems, tensions, barriers and missed opportunities for effective use of learning analytics systems. These consequently impedes on improvements in student learning and success at scale and their corresponding educational impacts on the whole of society. These five alignment issues and challenges are described below.

1. There is a widespread lack of knowledge and understanding about learning analytics and the concomitant need to select and use learning analytics systems for supporting learning, teaching and assessment; tracking progress; and, informing decision-making.

How should data inform practice? Who is prepared to analyze big data and who is the data analyzed for? Ethicists have pointed out that the purposes, actions and actors in an educational setting are a complex context of overlapping and sometimes competing interests (Ifenthaler & Schumacher, 2016; Roberts, Chang, & Gibson, 2017). This implies a need for a level of literacy to be achieved by all stakeholders in the system in order to support informed decision-making. What knowledge and skills are needed to understand the role of new data science methods and fit those with conventional qualitative and quantitative traditions of research? Some writers have called for a re-examination of the foundations of educational research in order to introduce data science methods into the open space that can potentially integrate qualitative and quantitative methods with AI-driven computational assistance and assistants. These writers have pointed out the current status and gaps in readiness of higher education to leverage learning analytics (Gibson & Ifenthaler, 2017). In particular what do students need to know to understand and be critical consumers of their own data and that of others? What can teachers do with all these data for their teaching activities and what feedback and monitoring of learning might students expect from learning analytics?

2. Guiding principles and policies need to be updated to help institutions make use of learning analytics.

Learning analytics can provide three kinds of information to students and teachers: summative, real-time or formative, and predictive insights from information prepared for decision-making and action (Ifenthaler, 2015). Today with the emerging potential to map sequences of the tools, communications and information utilized to solve a problem, the capability to build dynamic networks of the relationships of collaborating team members, and the computational resources to automatically classify and adapt curriculum materials in response to user interactions, the fields of learning design and analytics can be brought together as a new field of '*learning analytics design.*' The new field integrates learning or instructional design informed by data analytics and the design of learning analytics interactive dashboards guided by learning design. Advancements in learning analytics design have the potential for mapping the cognitive, social and physical states of the learner and to optimize learning environments on the fly (Ifenthaler, Gibson, & Dobozy, 2018).

Three analytics layers have been proposed for data-informed learning design (Hernández-Leo, Martinez-Maldonado, Pardo, Muñoz-Cristóbal, & Rodríguez-Triana, 2019): 1. analytics with a focus on learning decisions to be made by the learner (e.g., has the designed helped someone to learn), 2. analytics for decision-making by designers and teachers-as-designers (e.g. what

aspects of the learning design were effective), and 3. analytics of the impact of community-based pedagogy for teachers (e.g., co-design of learning, peer learning).

3. Standards are needed for ethical design and use of learning analytics systems by educational data services providers and users for ensuring quality (e.g., auditing, transparency, reporting, security, privacy, compliance, sustainability, and scalability).

One of the main concerns of learning analytics applications is the handling of data privacy issues (Prinsloo & Slade, 2014). As almost every learning analytics feature collects and processes user data by default, learning analytics designers need to consider each country's data privacy legislation, such as the European General Data Protection Regulation (EU-GDPR). A principle of learning analytics developed by several authors is that a person will not be fully understood by their data trail, no matter how that data improves and broadens (Prinsloo & Slade, 2014). Such issues have been documented in recent research studies regarding privacy issues and ethical dilemmas in learning analytics (Ifenthaler & Schumacher, 2016; West, Huijser, & Heath, 2016).

However, it is also well understood that the improvement of automated decision-making, personalization of learning and adaptation of the curriculum requires a complex, multifaceted and distributed data model of the learner (Mislevy, Behrens, Dicerbo, Frezzo, & West, 2012). Many questions are implied and remain concerning the features of such a model, how to distribute relevant features as needed in different contexts and how to re-unite features into more complex and dynamic pictures of learning progress and achievement.

4. Flexible and user-centered designed tools are needed for different learning levels, ages and stakeholder groups in their unique educational contexts.

Real-time analytics are increasingly feasible for example as support systems for teaching. Research has reported on systems that track and analyze online readings as lecture system support services (Shimada, Konomi, & Ogata, 2018), student response systems for attention and engagement (Heaslip, Donovan, & Cullen, 2014) and dashboards that visualize student progress and achievement (Roberts, Howell, & Seaman, 2017; Schumacher & Ifenthaler, 2018).

In the context of game-based learning, learning analytics features often adopts a dashboard approach to achieve transparency in progress and to empower decision-making by the user. Dashboards can map skill acquisition, show the ratio of successful students who reached the learning objectives, and provide various kinds of feedback to teachers and students (Thille & Zimmaro, 2017). Dashboards can be powerful learning tool for both teachers and learners, if developed with user-centered design (e.g., the functions for teachers to interpret learning data before decision-making).

Adaptation can be machine-automated to some extent, but perhaps of equal importance, active decision-making by key actors such as students and teachers can be empowered by technology with more timely and targeted information such as critical feedback on performance and comparative standing in relationship to a cohort. Assessment that is self-sought, self-discovered and self-controlled suggests a strong role for technology as a disinterested but trustworthy provider of information; some have called this 'quiet assessment' (Webb & Gibson, 2015) recognizing the empowering position of self-

determination and the role of AI and technology as a helpmate to a decision-maker (Ifenthaler, Greiff, & Gibson, 2018).

5. There is a need to apply and advance educationally relevant research-based knowledge to:

- engage key stakeholders of learning (e.g. students, parents, teachers, school leaders)
- create and ethically use rich data models and methodologies to advance learning
- integrate instructional theory, design and delivery with analytics data and insights
- safeguard security, privacy and control of data
- understand the impacts of combining data types from all sectors (health, socio-emotional, SES, etc.) on interactions with the individual
- enhance data interoperability with standardized measures
- confirm the logic and research models used by technology companies developing educational software

With large data sets becoming more available to teachers, learners and other stakeholders, some important issues are: who owns these data, which data are available to which users and for what purposes, as well as to the public and which are private?

Some teachers now use data to inform their practice. Their learners may have access to analytics performance information that may help them set their own pace and objectives. However, education institutions have different practices around data sharing and use. Whilst some institutions, for example, allow commercial providers to access data, the level of trusts in sharing data between institutions and providers, vary (Klein, Lester, Rangwala & Johri, 2019).

In a case study with 3,550 learners as well as linked follow-up studies (Ifenthaler, Gibson, & Zheng, 2018), navigational sequences and network graph analyses demonstrate the potential of learning analytics design by showing the most-used paths, characterizing path and learning affordance simplicity-to-complexity and the topological structure of the learning environment, and limiting the boundary of all possible paths of learning afforded by the problem space. Even with open-ended freedom of choice by learners in the initial study, only 608 sequences out of hundreds of millions of possible sequences were evidenced by learners. More recently, network analyses by the research team have led to new metrics of team collaboration by situating generic network measures in the specific context of collaborative teamwork in structured problem spaces.

Positive evidence has also been found on the use of learning analytics to support study success, but there is still a need for more evidence concerning the link between learning analytics and intervention measures to facilitate study success (Ifenthaler, Mah, & Yau, 2019).

It is also possible to automate certain features of the process of collection, identification of patterns, and creating options and adaptations. For example, in a game-like design, feedback can be nearly real-time by embedding response pathways and feedback about learner decisions into the digital code itself without resorting to deeper levels of analysis that require more time to collect and evaluate. What are the risks as well as the opportunities here?

Studies are also emerging that examine how instructors and students feel about various analytics opportunities, and find that people possess and base judgments on expectations

concerning learning (e.g., one must remember and perform on one's own without scaffolds) as well as teaching (e.g., too much scaffolding coddles learners) (Howell, Roberts, Seaman, & Gibson, 2018).

Possible actions to overcome misalignment

As new methods and models for data analysis and data representation (e.g., advanced statistics, dashboards, graphical visualizations for learner paths, semantic graphs or social networks, timing diagrams, etc.) continue to be elaborated and put to use, it is critical that stakeholders are enabled to understand the methods and models in order to know what is involved and to act consequently. To enable effective action, related literacies, in particular graphicacy and educational data literacy should be promoted. Educational data literacy is understood as the ethically responsible collection, management, analysis, comprehension, interpretation, and application of data from educational contexts (Sampson, et al., in press). Additional actions can be summarized as follows:

- Global differences in learning analytics impact uses, meanings, and methods.
- Advancing educational research is needed for analytics theory and methodology.
- Bridging data science and learning science requires improved frameworks as well as multidisciplinarity research and practice.
- Forms of collaboration and knowledge transfer with technology industry need to be proactively and critically developed and evaluated by the education sector.

Key insights from other TWGs

With reference to TWG4 (State of the art in thinking about machine learning – implications for education), learning analytics are closely linked to approaches of machine learning, as it is regarded as a way for computers to learn from data - for example detecting patterns, classifying data and making predictions. In addition, TWG10 (New paradigms for researching digital technologies: achieving scalability and sustainability) identified a need for research to identify how new research approaches are able to usefully inform sustainability and scalability of technological innovations, through continuous analysis and evaluation of what works for whom.

Strategies and actions

TWG6 recommends the following actions for policy makers (PM), researchers (R) and practitioners (PR) with each strategy linked to the corresponding challenges identified above (see Figure 1):

In order for evidence-based practice to be led by analytics:

- Develop learning analytics policy that focuses on leadership, professional learning, enabling mechanisms, and data governance. (PM, R)
- Ensure open access to resources and best practices is needed. (All)

To promote the adoption of learning analytics

- Develop standards, guiding principles and policies as well as best practices for the use of learning analytics (PM)
- Enable organizational change to support stakeholders to utilize learning analytics for learning. (PR)

To inform and guide data services providers and users:

- Promote trustworthy, ethical quality assurance through mechanisms such as standards, accreditation processes, audits and recommendations and procurement requirements. (PM)
- Promote sustainability and scalability, for example via embedded and just-in-time services. (R)

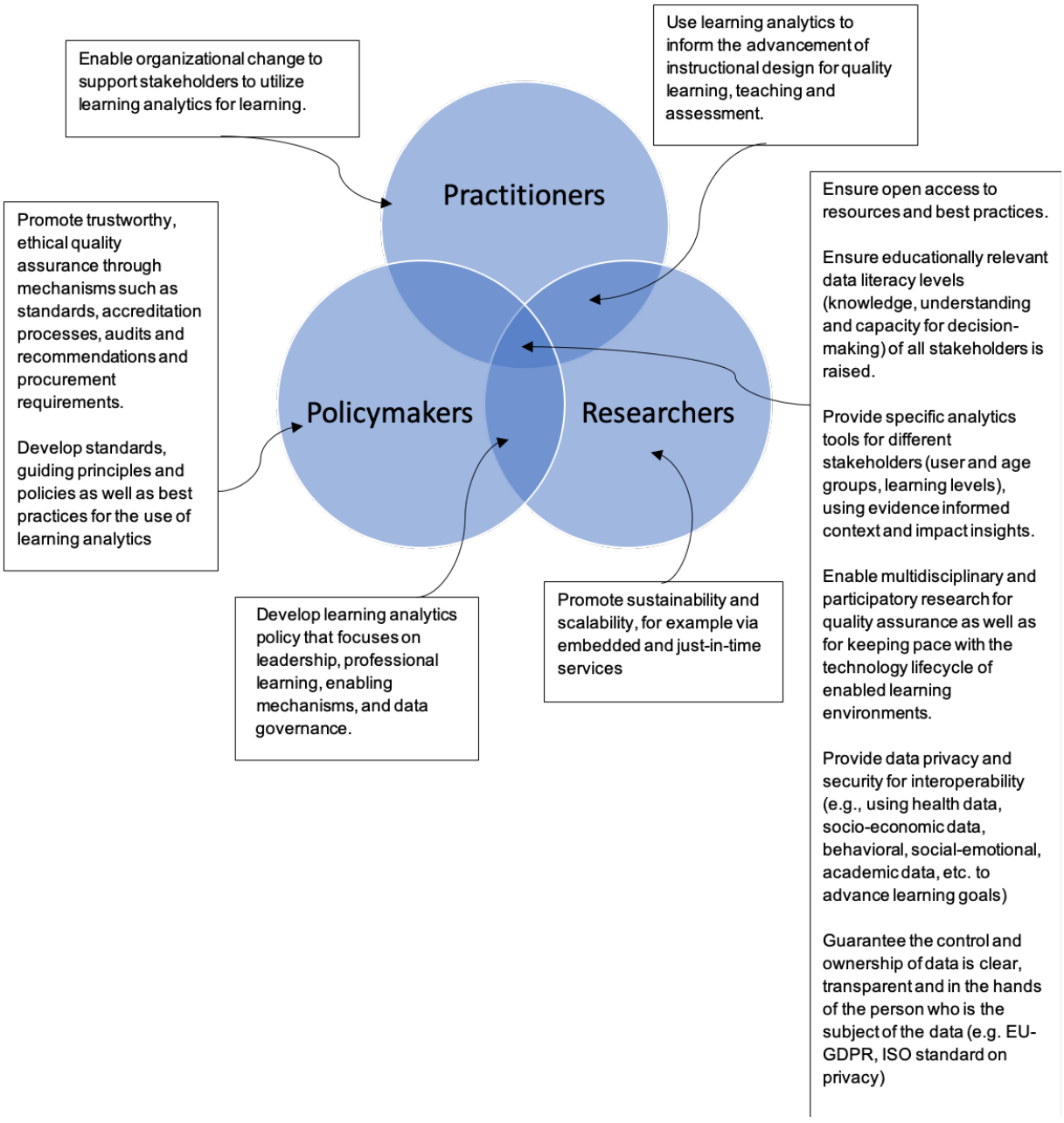

Figure 1 Actions for policy makers, researchers, and practitioners

To impact learning via analytics tools:

- Ensure educationally relevant data literacy levels (knowledge, understanding and capacity for decision-making) of all stakeholders is raised. (All)
- Provide specific analytics tools for different stakeholders (user and age groups, learning levels), using evidence informed context and impact insights. (All)

To leverage the relationship between instructional design and learning analytics, and to extend to course and curriculum analytics, e.g. via AI:

- Use learning analytics to inform the advancement of instructional design for quality learning, teaching and assessment. (R, PR)
- Enable multidisciplinary and participatory research for quality assurance as well as for keeping pace with the technology lifecycle of enabled learning environments. (All)

To understand the impacts of combining data types from all sectors (health, socio-emotional, SES, etc.) on interactions with individuals; improving data models and leveraging AI and related technologies.

- Provide data privacy and security for interoperability (e.g., using health data, socio-economic data, behavioral, social-emotional, academic data, etc. to advance learning goals) (All)
- Guarantee the control and ownership of data is clear, transparent and in the hands of the person who is the subject of the data (e.g. EU-GDPR, ISO standard on privacy) (All)

Actions from the TWG

The members will be invited to co-author a journal-length article based on the group's process, deliberations and outcomes from EDUsummIT 2019. Members are invited to utilize the outcomes of the meeting at conferences and to make presentations that include the group's ideas. The group is planning a symposium at the EdMedia Conference (Amsterdam, June 2020) to disseminate the work linked to outcomes of other TWGs.

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Thematic Working Group 7
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Connected Learning: Online Human Interaction and Interaction With Digital Resources

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Background

The work of TWG7 focuses on emerging ideas surrounding 'Connected Learning', exploring concepts associated with online human interactions and interactions with digital resources. This was a new thematic working group for the 2019 EDUsummIT and was conceptualized and bounded by this definition: Online interaction with people and with digital resources for learning purposes is becoming common practice for educators and students. In connected (or networked) learning, the emphasis is put on connections, be they connections between students from geographically distant classrooms and schools, regions, provinces, and countries as well as students engaged in MOOCs (Massive Open Online Courses). Connected learning environments are generally characterized by a sense of shared purpose, a focus on production, and openly networked infrastructures. Models that apply include learning communities, communities of practice, teacher networks, among others, all of which provide ways of bridging formal and informal learning environments and communities together.

Building on these foundational ideas of connected learning at the EDUsummIT, we arrived at the following definition shaped by discourse around two major themes of 'context' that is, connections made within and across bounded spaces such as the interrelationships between face to face, blended and online; as well as the second theme of 'the individual' that is, connections made based on the individual's interests, culture, relationships and opportunities. The following definition is presented here which framed our exploratory discourse:

In an age of ready access to people and information, connected learning is a combination of individual interests, networked and interdependent relationships, and interconnected experiences that transcend temporal, spatial and cultural boundaries. Connected learning leverages media and technology for expanded access to global communities and cross-cultural and interdisciplinary learning pathways across the lifespan. Connected learning involves socially embedded and interest- driven interactions among diverse participants who collaborate, co-create, re-craft and leverage each other's diverse insights and perspectives while building knowledge in and for community.

Alignment issues and challenges

Our main question was: under what conditions, for which learners, for what purpose, in which contexts does connected learning work?

Connected learning can be "realized (simply) when a person is able to pursue a personal interest or passion with the support of friends and caring adults, and is in turn able to link this learning and interest to academic achievement, career success or civic engagement" (Ito et al. 2013). The purpose of connected learning is to enrich the imparting of foundational literacy and knowledge, while also diversifying and multiplying pathways to opportunity and meaningful participation in society. Therefore, connected learning does not reduce learning to a phenomenon that takes place exclusively in the restricted spaces of formal education, neither does it focus exclusively on the online learning phenomenon. Rather, it refers to any learning experience where people co-create artefacts meaningful to their community (centred production), which affords abundant resources accessible to all (openly networked) who share a common purpose (shared purpose). This agrees with Hyett et al. (2019) when saying that internationalized learning through virtual technologies increases globalized and cosmopolitan societies that have the potential to facilitate transformative intercultural learning experiences and build cultural competency. As such the following major issues and challenges helped us conceptualize connected learning:

Issues and challenges in connected learning include:

- **open and bounded contexts**: free range in the context of privacy, security and ethical constraints;
- **global and local issues**: policy, practices and programs; the continuum of linguistic, ethnic, cultural, economic, epistemological diversity,
- **top down and bottom up approaches**: goals, agency, decision-making, identity, risk-taking (institution: teacher; school leader: teacher; teacher: learner); national or provincial/state curriculum and assessment: teacher professionalism, choice and autonomy;
- **emergence vs prescribed curriculum:** expanded connected approaches versus standardized curricular and assessment frameworks;
- idealized connected learning within formal structures and systems: explore assumptions, concessions, caveats;
- **rise of a new class of social influencers, entrepreneurs, and leaders who leverage power of network and social media**: Whose voices and perspectives are privileged; whose are excluded; Authoritative knowledge and expertise versus fake news /opinion?

What we consider 'learning' may need to be re-conceptualized as a result of connected learning. For students, researchers typically focused on canonized school-based 'learning', with reference to discipline specific knowledge gains. However, with regard to connected learning, we need to be moving towards considering learning as 'mashups' of discipline knowledge with personal interests as well as other's social duties as learning paradigms.

A strong nuance about connected learning is that it is self-generated rather than externally determined meaning that a quasi-environment may be 'created' but the learning connections are self-generated. In describing this in another way, it is possible to conceive of an educational center which offers a refreshing new model based on an idea in communications: a "pulling effort" on the part of the learner rather than the "pushing effort" on the part of the teaching institution.

Some examples

In high school students for example, the spontaneous creation of private ways to communicate through social media is common: Facebook groups, Messenger groups, Snapchat or other interfaces, with none of them dedicated to learning. Whereas, more formal school-based discussion forums are the favorite web application for students to ask questions to their peers about homework. In these forums, studies have shown that students are mainly looking for explanations rather than only the answers to the exercises (Faillet, in press). However, there is evidence that school-related questions colonize non-school-related forums (e. g. forums dedicated to Horses or Firefighting). This reveals that students can pursue a personal interest or passion with the support of peers and can link this interest to academic achievement – a connected learning.

In Quebec, Remote Networked Schools (RNS) is a ministerial initiative which uses information and communication technologies (ICT) for enriching the learning environment of small geographic isolation K-12 rural schools. These schools frequently encountered challenges such as lack of specialized resources for students, multi-grade classrooms, small numbers of registered students and professional isolation (Turcotte, 2008). In 2016, RNS was giving 250 schools located in 31 school districts access to information and tools such as videoconferencing (Via), Knowledge Forum (KF) and online shared catalogue of activities (Laferrière et al. 2016). As an open environment, their classrooms use resources that are accessible through the Internet. Class activities consist of performing knowledge co-development activities using Via, classroom discussion or peer-to-peer exercises on a routine basis (Laferrière et al. 2016) in order to foster a student-centered learning environment for collaborative knowledge-building (Bereiter & Scardamalia, 2010). RNS class discourses revolve around students' questions (as interest-powered) and puts their ideas into a process of co-development of knowledge (peer-supported) which constitutes a trace (production-centered) of the evolution of their collective discourse where ideas evolve and improve through the negotiation of meaning (Laferrière, 2005). The collective discourse is guided, on the one hand, by teachers who strategically scaffold learners' collaboration according to the educational aims (academically oriented), and, on the other hand, by students who are trying to understand deep disciplinary content (Turcotte, 2008). Thus, RNS set a learning community in an openly networked environment which is peer-supported, interest-powered and academically oriented.

A similar initiative has been launched several years ago in a region of France (Auvergne) and a first experience of a MOOC (Massive Open Online Course) linking primary isolated schools in Quebec, Tunisia and France was organized in spring 2018 (see Ghabara, 2018). MOOCs can use a connectivist paradigm as networks of people and resources where users can design, pace and direct their own learning (Siemens and Downes, 2008). However, the current dominant MOOCs from most popular platforms (as Coursera, edX, FutureLearn, FUN, Iversity) are not connectivist, favoring a classic mode that can be described as instructivist. Additionally, we can characterize MOOCs as a new form of distance learning, with courses taking place in a given time or at any time and open to social networks (Dron, & Ardito, 2018).

In Figure 1 we explore connected interactions in regard to learning outcomes of peer culture, interests, and academic content from a range of perspectives (people, space, resources) to elucidate the true nature of connected interactions that are dynamically expanding what we consider as 'learning'.

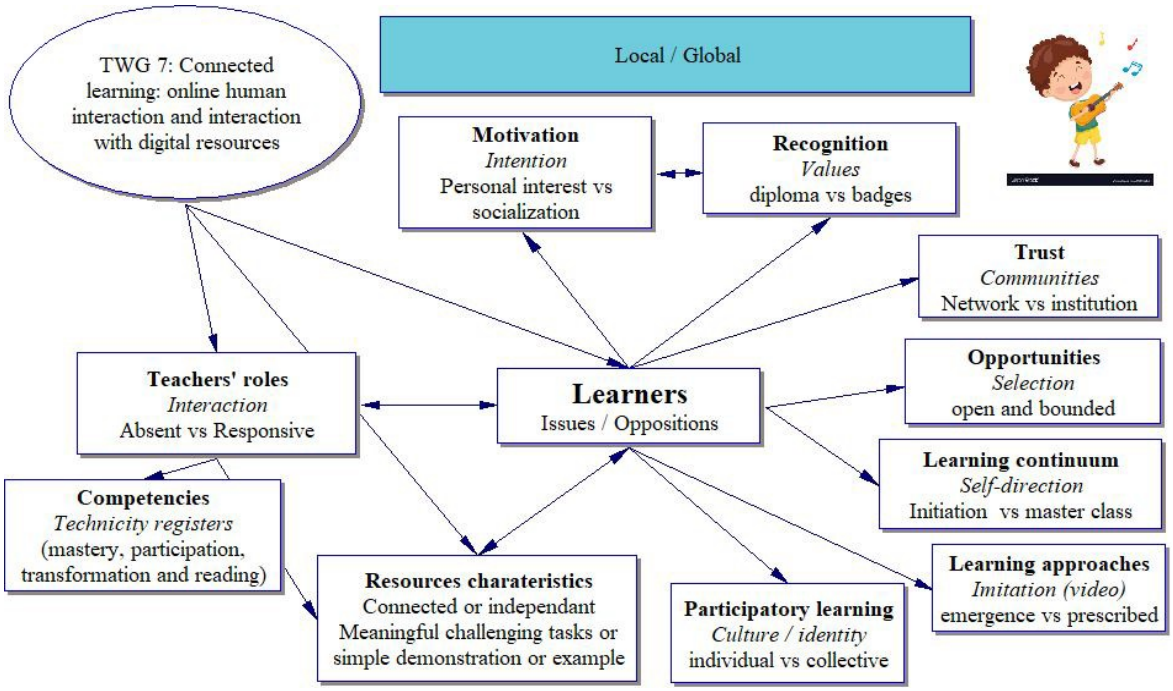

Figure 1 Synthesizing Connected Learning
(the elaboration of the map was partly based on the case of learning to play the guitar, which explains the little character at the top right)

In Figure 1 'Learners' are the central focal point rather than the Instructor, Institution or disciplinary knowledge. Context does not necessarily matter as bounded by location (local or global) rather the space of the 'interaction' is more important. Connected learning through the individual is influenced by many elements such as motivation, recognition, trust, opportunities, learning approach/continuum/ style, resources and the teacher (if present) in the connected context. Each element has possible parameters which therefore influence the dynamics of interactions.

Possible actions to overcome misalignment

Connected learning opens new doors to an array of formal, non-formal and informal opportunities. For example

- Formal university level education is responding by providing MOOCs, customized course work, flexible pathways, as well as greater on-campus and online delivery methods,
- Non-formal learning has structures such as courses that provide non-academic certification offered by any entity or individual instructor not necessarily aligned with any formal institution,
- Informal learning is at a personal unstructured interest based level which may include virtual visits to museums, libraries, zoos and or social media interactions on YouTube or Snapchat or Twitter for example.
- Just-in-time (immediate need) versus just-in-case learning (might need in the future).

Notable emerging ideas related to recognition by society in general are emerging through connected learning. These include

- Online Education is gaining respect in society in general but there is still evidence of resistance to the acknowledgement of the intrinsic quality of online education. Online education can offer good but different education. However, there is still a body of thought that does not believe it is as valuable as in-person course work.
- Self-directed learning can enable the individual to choose tailor-made pathways that are made up of a variety of courses delivered online in various forms world-wide.
- The sources of information in society have expanded to include the social influencers.

Other emerging ideas that help us to understand connected learning include:

- Collaboration: working together for a greater result and building upon one another's work;
- Relationships: there may be "winners and losers" in instructed interactions with less trust, more individual or one on one;
- Participatory vs Individualistic: expanding the notion of self-regulation: what does that look like in the collective?
- Accessibility: removing barriers-of all kinds.

One example of misalignment is evident in our current understanding of teacher professional development. Continuing professional development can take the form of formal, non-formal, informal and just-in-time learning, Teachers often turn to online connected spaces to augment their professional development due to the irrelevance of what is offered at the school site (Prestridge & Main, 2018). Researchers have agreed that professional learning experiences should be long-term, ongoing, social, constructivist, and situated in classroom practice (e.g., Desimone, 2009). Yet, traditional teacher professional development often fails to meet such criteria. From this perspective, the social constructivist activities available through connected learning leveraged by digital spaces are different to those in more traditional face-to-face spaces. Supported by teachers' uses of social web technologies, the development of various forms of teacher collectives can be observed in many countries (Lantz-Andersson & al., 2018, p. 303). Leveraging the connections between formal, non-formal, in-formal and just-in-time teacher learning provides greater possibilities, relationships and connections to learning that meet the teacher's professional learning needs and interests.

Key insights from other TWGs

Many of the Thematic Groups were related to our explorations of connected learning and provided different schools of thought to extend our understandings. For example, Thematic Group 1 focused on human computer interactions. This inquiry shaped our understanding of 'context', how we consider interactions support by innovations in technologies such as wearable or augmented reality, which also shaped our consideration of time and type of interaction. Consequently, connected learning could be understood in relation to an individual's 'interaction' within and through technology without a human counterpart. Consideration of the greater opportunities for connected learning that are leveraged by new technologies are shaping work practices which in turn shape educational practices. Thematic Group 11 focused on the use of technologies for cross-cultural alignments. Given the dominance of connected learning being contextualized by English-written or spoken language, greater importance is needed for the preservation of natural languages. Also, as new computer programs are made available that automatically translate text; as mobility and access to the internet and hardware/devices increases in developing countries; and as immersive environments are expanding collaborative opportunities, connected learning is more expansive and relational to mainstream education and training. With the growth and expansion of connected learning new ways of working with and across cultural contexts are required.

Strategies and actions for policy makers, practitioners and actions for researchers

For policy makers one of the main issues with connected learning is the level and approach to regulation for education quality and value. These issues are complex in this field as independent providers are able to use connected learning spaces without formal regulations. Levels of certification; cost, access, flexibility of learning events; and divergent pathways to employment are fueling the diversification of what is valued by the user/learner.

For the educator, the major focus is to develop competencies in learners for engagement in connected learning. Self-regulation and entrepreneurship are key elements that position learners as both directing and maintaining active engagement in connected spaces. Additionally, learning opportunities that make learning more visible and develop metacognition are important.

For researchers, there is much to conceptualize and investigate within the field of connected learning. Connected theories, frameworks, models and design principles need to be defined and used to guide inquiry and practice. Multi-disciplinary studies which consider connected learning in relation to broader issues and fields of inquiry are necessary to build breadth of implications to fundamental social, work and cultural practices.

Concluding comments

To deal adequately with this entirely new universe, its components and potential, professional educators today are discovering that the theoretical frameworks which oriented "learning" in

the past have so far been unable to furnish all of the new principles, criteria and tools now needed for understanding and "measuring" the complex issue of successful acquisition of knowledge and skills. To Behaviorism, Cognitivism, and Constructivism, are now added new approaches to recently-developed and dynamic human activities, such as Connectivism and Connected Learning, the latter being the subject of our present study.

Connected Learning, also known as Networked Learning, began in the 1990s principally in K-12 studies, but subsequently expanded to include learners of all ages and, potentially, most areas of human knowledge and their acquisition. Considering the abundance of information suitable for learning available on the web today, its first principle is to encourage learners new to digital technology to seek out subjects which are of strong personal interest and which provide ample continuing motivation for study. Perhaps a brief and adequately succinct definition for Connected Learning, and the implications for teaching and learning, which is that found in Educause´s Learning Initiative (2013): "…how to use connections to find answers, seek out mentors and experts, investigate procedures, experiment with possibilities, and develop competencies." We have only just begun to elaborate on this fascinating and critically-important new element in the teaching and learning process.

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Thematic Working Group 8
-
Pedagogical Reasoning and Reflective Practice: A Framework for Teaching in a Digital Age

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Background

Pedagogical reasoning and reflective practice are important means for teachers to continually professionalize and improve their teaching. These concepts also help us to understand why, how and with what results practicing and prospective teachers use technology in their teaching. This emancipative form of professional development taps into teacher agency for digital technologies and resources (Albion & Tondeur, 2018). It is also critical for bringing new teachers into the practice, and enhancing the techno-pedagogical skills, knowledge and action through the joint lens' of TPACK (Technological Pedagogical Content Knowledge) and PR&A (Technological Pedagogical Reasoning and Action). This is particularly important when considering the transition from novice to expert educator using technologies, and for understanding the possibilities of transforming teaching and learning through teacher education (Forkosh-Baruch, 2018).

Teachers' professional knowledge has been researched and discussed at length by educators, researchers and policy makers for many decades. The extensive body of literature reporting findings from research describes differing forms of teacher knowledge as either theoretical knowledge or practical knowledge, or in Fenstermacher's (1994) terms Formal Knowledge – "one's knowledge claims must be justified in such a manner that they range beyond the immediate context, situation, or slice of time" (p. 28) - and Practical Knowledge – "to claim to know something practically is to claim to know something about an action, event, or situation in this particular instance" (p.28).

To better understand the 'what' and 'how' of teachers' work, many have argued that exploring why teachers make certain decisions is important (for example see: Niess, 2019; Forkosh-Baruch & Avidov Ungar, 2019). Making sense of the 'why', however, comes with its own

challenges because much of that thinking – the pedagogical reasoning – underpinning practice has long been recognized as tacit in nature (Polanyi, 1966).

The connection between teachers' knowledge and their actions is evidenced in Shulman's (1987) work outlining a knowledge base for teaching and a model of Pedagogical Reasoning and Action (PR&A). This resulted in six non-linear decision-making steps which help identify the unseen aspects of practice (Loughran, Keast, & Cooper, 2016, p. 388) and allows teachers to demonstrate their capacities as an expert pedagogue (Berliner, 1986). However, we fine-tuned the PR&A definition, redefining it as an ongoing process by which a teacher develops and articulates theoretical and/or practical understandings to describe why, what & how their practices lead to sustainable learning.

Hence, the objectives of our TWG were to:

1. Exchange ideas regarding recent research, policy developments and teacher practices highlighting the role of knowledge and PR&A related to technology integration education. The outcome was the identification of key issues and trends in research, policy and practice.
2. Identify and pinpoint the role of technology in PR&A, in teaching, learning and decision-making.
3. Examine possible actions to promote teachers' knowledge and PR&A to enhance wise utilization of technology in education and reflective practices.
4. Discuss implications and make recommendations for policy, practice and research.

As a result of TWG discussions, we identified three themes relevant to PR&A in relation to new alignments for learners and their learning contexts, namely:

1. How might we better connect understandings of teachers' knowledge to their classroom practices in technological-rich contexts? (Harris and Phillips, 2018; Heinonen et al., 2019; Heitink, et al., 2016; Holmberg, Fransson, & Fors, 2018; Tondeur, Van Braak, Ertmer, & Ottenbreit-Leftwich, 2017)
2. What new ethical challenges are presented to teachers' decision-making when educational technologies are used in classrooms? (Burbules & Callister, 2018; de Zwart, Henderson, Lindsay, & Phillips, 2011; Selwyn Nemorin & Johnson, 2017)
3. How does the PR&A of pre- and in-service teachers differ? How might we better develop the decisions of all teachers? (Lloyd, 2019; Loughran, Keast and Cooper, 2016; Niess & Gillow-Wiles, 2017; Smits, Voogt, & van Velze, 2018)

Alignment issues and challenges

Next, we identified current misalignments referring to the identified themes. These may be considered as challenges for pedagogical reasoning and reflective practice for teaching in a digital age, as follows:

Connecting knowledge and action in technological-rich contexts

- We currently have models of teacher knowledge and of teacher decision-making; however, these models are separate from one another. Separation of knowledge and decision-making is a misalignment.

- We do not have an integrated model that considers teachers' attitudes, beliefs and dispositions together with teachers' knowledge to better understand their decision-making processes. Lack of a more comprehensive model is a misalignment.

Ethical decision-making based on PR&A

- Teachers are increasingly required to make classroom decisions based on the data provided by software developed by third party commercial companies. The algorithms that generate these data are not transparent creating challenges for teachers to make effective decisions. Lack of transparency in third party software as a misalignment.
- The increased prevalence of learning analytics software, often imposed upon teachers by system or school leaders, threatens to automate many classroom decisions and reduce teachers to managers rather than active, professional decision-makers. PR&A as a hallmark of professional teachers and the automation of their decisions is a misalignment.

PR&A of pre- and in-service teachers

- Preservice teachers lack practical-authentic experience –this results in limited opportunities for decision-making and self-reflection opportunities. Lack of guided professional experience for pre-service teachers is a misalignment.
- In-service teachers are often isolated in terms of exposure to different practices, which can limit their decision-making repertoire. Lack of ongoing, shared classroom experiences is a misalignment.

Possible actions to overcome misalignment

In an attempt to propose actions that overcome misalignments, we identified emerging new alignments that may promote pedagogical reasoning, action and reflective practice. The main ideas are presented according to the TWG themes:

Connecting knowledge and action in technological-rich contexts: we propose representations of teachers' epistemic frames that will provide new opportunities to connect teachers' knowledge, attitudes, beliefs and dispositions with their decision-making processes. This may provide additional reflective opportunities and a more comprehensive PR&A model that may in turn create a better link between practice and the underlying dispositions held by educators.

Ethical decision-making based on PR&A: we propose that policymakers develop a code of conduct that requires software developers to make decision-making algorithms more transparent for educators, for example, by using plain language and detailing the rationale for interpreting data. This would allow teachers to understand the basis for software recommendations and to be able to make autonomous decisions regarding the appropriateness of software recommendations for their classroom practice. This will allow fruitful partnership between developers, policymakers and educators, thereby involving educators in software development processes, in a quality assurance iterative procedure – for the students' benefit.

PR&A of pre- and in-service teachers: in-service and pre-service teachers should be provided with opportunities to enhance their repertoire of available decisions in order to empower their PR&A. this may be achieved by sharing classroom experiences collaboratively, utilizing digital simulations or text-based scenarios involving teams of educators, either focused on subject matters or generic pedagogical reasoning. This approach can also lead to development of evidence that may be accumulated in an online depository – for the benefit of preservice or in-service teachers (possibly the freshness and innovativeness of the former and the experience of the latter will allow all educators to benefit from this initiative). Making decision-making processes and reflective practices explicit will create new authentic learning opportunities for preservice teachers.

Key insights from other TWGs

We were visited by two TWG representatives: TWG2: learners as learning leaders: how does leadership for learning emerge beyond the traditional teaching models? And TWG6: putting learning back into learning analytics: optimizing learning through analyzing the data. Following these interactions, as well as casual conversations with, and plenary exposure to other TWGs, some insights followed:

a. A need for clarification of what is included in pedagogical reasoning and action – definition of this concept required re-thinking. Hence, and updated definition was formed.
b. In addition to the teacher, we further broadened the role of the learner as practicing pedagogical reasoning and action. We think learners should also be reflective in their utilization of ICT – by this, we allow them the autonomy and authenticity that we found so important for the teacher. Furthermore, this may enhance their future e-citizenship.
c. Learning analytics is an issue that needs further examination, since this field is "under construction". Therefore, we emphasized the importance of taking into account a) teachers' experience (perhaps involve teachers in developing this field) and b) ethical issues involved in this, e.g., tagging students based on ill-interpreted performance.

Strategies and actions

EDUsummIT findings focused on three inter-related levels of strategies and actions, detailed herewith.

Strategies and actions for policy makers

Policy recommendations include, first and foremost, the notion that PR&A must be an individual consideration, rather than a systemic endeavor. In fact, much of the high-level reasoning is performed in a top-down manner, usually by policymakers and inaccessible to practitioners or to students. Hence, it does not impact users' practice and does not develop their own PR&A. The empowerment of teachers' utilization of educational technologies must be addressed through policy initiatives. These should focus on ways to improve teachers' PR&A via TPACK-related professional development initiatives. Special attention should be allocated to teachers' pedagogical beliefs, thereby connecting between them and PR&A. Therefore:

- Individual teacher PR&A is an essential aspect of effective, sustainable educational technology integration and enhanced learning outcomes;
- PR&A must be an individual consideration rather than a systemic endeavor. Teachers should be able to develop their personal reflective and decision-making processes for their particular context. Time needs to be allocated to allow for teacher professional development to engage in these progressions;
- A code of conduct should be developed that requires software developers to detail decision-making algorithms in plain language allowing teachers to make autonomous decisions about the appropriateness of their use in classrooms.

Strategies and actions for practitioners

Practice recommendations should be divided into four major layers: teacher educators, in-service professional development, pre-service teacher education, and students. The major focus should be on pre-service education. Preservice teachers need assistance in pedagogical reasoning regarding technology-supported teaching and learning in the subject matter they specialize in their training. Consequently, they can lead PR&A processes within innovative practices in their schools, and become educational leaders. In-service teachers should participate in professional development training to empower their PR&A, in face-to-face meetings, but also online, utilizing video-recording of lessons, which may serve as learning materials. These lessons can be analyzed by groups of teachers from the same subject matter or of different specialization areas. Learning from best practices as well as from failures within school staff and possibly also across schools – by homogeneous subject matter groups of teachers – will raise teachers' awareness regarding educational technology implementation considerations. Students should also be encouraged to make informed decisions regarding their technology utilization, since the choice of technological interfaces, applications or platforms should be at times their choice; this is relevant for content-based as well as for generic software. Students, sometimes being more technology-proficient than their teachers, must be taken one step further, thereby connecting between their technology skills and learning processes. As for teacher educators, they need to experience the same PR&A processes regarding digital technology implementation; however, they can accompany their practice with research. To conclude:

- Broaden professional development opportunities (including digital simulations and augmentations). PR&A about technology integration could be undertaken collaboratively or individually;
- Teacher educators should explicitly develop, model and discuss PR&A in relation to educational technology integration with their students;
- Encourage leadership within the teaching community to develop a culture of PR&A, that will in turn impact learning and learning outcomes.

Strategies and actions for researchers

Research recommendations focus on the need to further examine factors involved in educators' PR&A, in order to fully understand educational decision-making with regards to ICT implementation. Factors should include contextual components, e.g., the TPACK model, as well as variables such as teachers' beliefs and digital technology proficiency, as well as students' age, interests, talents etc. Ethical aspects need to also be addressed to a greater extent, as technology is developing rapidly and penetrating our lives altogether, and our

professional lives in particular. This may cause restrictions regarding technology utilization, therefore requires examination of its consequences. Actions include:

- Extant literature in related fields provides opportunities to connect aspects of epistemic frames to conceptualizations of teacher knowledge and their connection to action;
- Broaden the use of developing software to examine the correlations between elements of teachers' epistemic frames;
- Co-explore the current reasoning with practitioners to develop a nuanced understanding of the aspects of knowledge, beliefs and attitudes that underpin practice in different contexts.

Actions from the TWG

While digital technologies are becoming more common in schools and in teacher education, PR&A regarding educational technology utilization is becoming more complicated and requires training of teachers, teacher educators and even students. Our TWG was composed mostly of researchers, but some members are connected directly to teacher training programs; hence, they work with preservice as well as in-service teachers. The advantage of combining research and practice is well within the scope of action for our TWG members. As for policy, this may be achieved by publishing our recommendations, thereby allowing public debate on this issue. Since TWG members are from diverse countries and cultures, this may influence the implementation of our recommendation; while we are aware of this, we strongly emphasize the role and necessary autonomy of the teacher in pedagogical reasoning and action.

Figure 1 Members of TWG8 at EDUsummIT 2019

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Thematic Working Group 9
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Advancing Conceptual Models of Technology Integration in Education: Implications for Researchers, Practitioners and Policymakers

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Background

One of the ongoing barriers to the effective uptake and uses of Information and Communication Technologies (ICT) in education has been the varied and sometimes inappropriate conceptual understandings that drive integration. While it is no surprise that there is a large variety of different conceptions among policy-makers, administrators and teachers, it is rather surprising that there is as much diversity when it comes to conceptual models that are developed and used in research (Niederhauser & Lindstrom, 2018; Sosa & Manzuoli, 2019). Although some diversity can be valuable to discover new aspects and to drive innovation, too much diversity is counterproductive as it hinders cumulative knowledge building and fails to provide coherent guidelines for practitioners. The reasons for this diversity of conceptual models are multifaceted. Conceptual models rely on different theoretical schools of thought. They have slightly different foci and scope. Sometimes, they also depict similar phenomena with different terminology. Furthermore, models come to different conclusions based on different research methodologies. As a consequence, there are no clear quality criteria for conceptual models of educational technology integration, and practitioners often times judge models based on visual appeal rather than on scientific validity (Kimmons & Hall, 2018).

To advance research on technology integration in education, it is paramount to develop high quality conceptual models that provide a joint perspective and can serve as core concepts for future research and practice. Therefore, the working group sought to 1) collect and compare the most prominent models for technology integration in educational settings, 2) develop guidelines to assess the quality and the scope of different conceptual models – combining criteria for policy-makers, practitioners and researchers and 3) provide an overarching framework to categorize and combine different conceptual models with the initial aim to

develop conceptual "supermodels" of technology integration in education. In addition, directions for future activities were discussed and recommendations were formulated.

Alignment challenges

In past decades researchers and practitioners have proposed numerous conceptual models on how technology can be successfully integrated into schools (e.g., Christensen & Knezek, 2001; Mishra & Koehler, 2006). Conceptual models are especially promising in this regard as they provide a simplified representation of the complex interplay of factors underlying the integration of technology in teaching and learning processes in schools. These typically use graphical representations, which make them easy to understand and to communicate. Models can also be empirically tested and validated. Some models have triggered international research efforts (e.g., the TPACK model by Koehler & Mishra, 2009; Mishra & Koehler, 2006; the "Will-Skill-Tool" or "Will-Skill-Tool-Pedagogy" Model by Christensen & Knezek, 2001; Knezek & Christensen, 2016; or Technology Acceptance Models, e.g. by Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003) while others have remained rather practically oriented (e.g. the SAMR Model by Puentedura, 2006, 2012; or the 4InBalance Model of Kennisnet, 2001). Early models tended to focus on the removal of barriers (anxieties, fears), while more recent ones have featured continuous or step-wise development of knowledge and skills. In the 21st century, pedagogical practices incorporating technologies have become widely acknowledged as very important, whereas before, these were largely overlooked. In addition, more recent models tend to combine factors on different levels of the educational system and combine them within a multilevel perspective (Voogt, Knezek, Christensen, & Lai, 2018). This current situation can be summarized as follows:

1. There is no consensus as to what characteristics define conceptual models in the field of technology integration in education, or how they differ from theories, taxonomies and frameworks.
2. There are few guidelines for finding suitable conceptual models targeting different purposes, contexts and stakeholders.
3. There is insufficient agreement on dimensions and indicators to judge the quality of these conceptual models.
4. Previous models have often focused on single level factors, such as teacher or school factors, while omitting other levels such as learner factors and context specific aspects.

Possible actions to overcome misalignment

In the philosophy of science, theories are typically understood as coherent and valid sets of statements describing specific phenomena in a more abstract and generalizable way. Theories identify core aspects and define relationships between these by means of cause-effect-statements or more complex logical or mathematical rules. In empirical sciences, theories need to be backed by studies verifying the hypotheses that are connected to these theories. Conceptual models are closely related to theories, but models can be viewed as being somewhat more specific in nature and connected to more recent pragmatic views of theories (Frigg & Hartmann, 2018; Grønfeldt Winther, 2015).

Conceptual models can bridge highly complex theories with practical applications. They can be seen as more simplified versions of theories or as working assumptions for aspects that are not yet completely theoretically clarified. Typically, models can be depicted visually, which make them highly suitable to be communicated and applied in practice. In contrast to frameworks or taxonomies, models can be used to make causal inferences between factors. Conceptual models are assumed to be beneficial for the formation of mental models, which guide everyday behavior and reflection (Johnson-Laird, 2013). Following the pragmatic notion of conceptual models, the working group proposes that good models should be aligned to science-oriented as well as practice-oriented quality criteria. Therefore, we propose the following four quality dimensions and related indicators:

Goal orientation: A good conceptual model of technology integration:
- focuses on educational practice and/or learning
- helps to specify the role of ICT for educational purposes
- incorporates contributions of stakeholders
- helps to analyze contextual conditions
- describes dynamic processes
- proposes mechanisms for technology integration

Reduction of complexity: A good conceptual model of technology integration:
- catches attention
- is clearly conceptualized
- focuses on most important aspects
- simplifies relations between aspects
- has a Gestalt/ontology

Validation: A good conceptual model of technology integration:
- relates to other models / frameworks / theories
- demonstrates expert validity: practitioners and researchers
- demonstrates construct validity
- is empirically tested
- acknowledges known limitations

Generalizability / specificity: A good conceptual model of technology integration:
- displays sensitivity to context
- applies to specific/multiple aggregation levels of the educational system
- is relevant for different grade or educational levels

Key insights from other working groups

Good conceptual models should not imply a technocratic view of technology integration but inspire confidence to find locally appropriate solutions. Ultimately, technology integration needs to be seen as a creative design process, involving different (f)actors at different aggregation levels. Moreover, the complex and unique local contexts should be taken into account (Laurillard, 2018; Warr & Mishra, 2019). Creative design processes also involve a sense of urgency, a sense of community, support from school leadership, a design team and a risk-friendly environment to test out new ideas. Consequently, conceptual models are meant

to be an aid for processes of technology leadership and change, not fixed recipes for change. Although the importance of educational leadership for technology integration has been stressed by many studies and authors, the use of conceptual models in this process needs to be investigated more closely (McLeod, 2018). In addition, the value of conceptual models for teacher agency and teacher leadership needs to be considered in future research.

Strategies and actions

In order to identify and use appropriate conceptual models of technology integration in education to guide the implementation process, policy makers, practitioners and researchers are encouraged to adhere to the following guidelines.

Strategies and actions for policy makers

- Align technology-integration policies with quality conceptual models
- Ensure the quality of conceptual models used to design policies
- Use quality conceptual models as tools for discussions among relevant stakeholders

Strategies and actions for practitioners

- Align technology-integration practices with quality conceptual models
- Use proven conceptual models to design integration strategies
- Use quality conceptual models as tools for discussions among relevant stakeholders

Strategies and actions for researchers

- Use the quality criteria described in this document to develop and expand technology integration models
- Build upon existing models and elaborate on relevant aspects
- Strive for conceptual and empirical validation of technology integration models
- Expand technology integration models to include learner-related and contextual aspects

Summary and Conclusions

The goal of this working group was to provide researchers, practitioners and policymakers with an overview of existing conceptual models of technology integration in educational settings and to provide recommendations for further refinements and practical uses. The working group has developed a framework that can be used to determine the scope of different existing models. The framework uses the metaphor of a platform or “stage” where different conceptual models can be grouped and compared. Therefore, the framework was called a “stage for technology integration models” (STIM). Within this framework, technology integration models are grouped along six distinct areas, including micro-, meso- and macro-factors on the side of either the teacher or the student. Without going into details - as a more detailed article on this framework will follow - the resulting six areas can be described as follows: 1) teaching with technology (teacher-related micro-level), 2) learning with technology (student-related micro-level), 3) teacher characteristics (teacher-related meso-level), 4) student characteristics (student-related meso-level), 5) teacher context (teacher-related macro-level) and 6) student context (student-related macro-level). While some technology integration models focus exclusively on one of these areas, others provide broader views.

STIM helps to visualize the added value of conceptual models and to identify blind spots that have to be addressed in future research.

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Thematic Working Group 10
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New Approaches and Paradigms for Researching Digital Technologies: Achieving Scalability and Sustainability

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Background

For technological innovations in education to be sustainable and scalable, it is critical to support these efforts through research that is embedded in context and developed in collaboration with stakeholders. In the initial thematic group description, a specific focus was identified as:

Design research, design-based implementation research (DBIR), research-practice partnerships and learning analytics/big data was identified as new research paradigms that especially call for the participation of practitioners for co-designing and conducting research projects along with researchers. These developments pose new issues and challenges for research at the local level to large scale national and international research studies. New paradigms need to be developed which help to overcome the limits of more established research approaches and of current meta-analyses. Additionally, new learning environments and borderless learning present further challenges to researching IT in education and require strategies to find ways in which more locally designed based research might co-exist with more distant forms of data gathering and analysis?

However, the group has reconceptualized "new paradigms" in terms of learning environments, rather than research approaches. We argue that in contemporary educational spaces, learning and teaching contexts include physical, online, and digital spaces, which may be formal, informal, or non-formal. To fully explore learning and teaching in this new paradigm, new approaches to the research underpinning technological innovation are needed. It is from this position that we have explored the nature and potential of sustainability and scalability in researching digital technologies in education.

This argument extends from the work of TWG9 from EDUsummIT 2017 (see Niederhauser et al., 2018). TWG9 argued that, while there have been several decades of educational technology research, this work has struggled to result in financial return, positive impact on learning, or motivation for teachers to integrate digital technologies in their practice. At the heart of these issues, findings point to the fact that digital technologies cannot simply be provided to teachers and learners. New technologies, and innovations must be purposefully

integrated into the learning environment, with the intention of supporting sustainability in practice and potential scalability to other learning contexts.

The previous working group defined Sustainability as “ongoing change” of an innovation in a given context, while Scalability was understood as “dissemination of change across different contexts” (Niederhauser et al., 2018, p. 508). However, as stated by Niederhauser et al. (2018) achieving sustainability and scalability has proven difficult in technological innovation and digital technology integration. TWG10 argues that this has contributed to more than a lack in success of change initiatives and innovations. It has resulted in educators’ disengagement with change, lack of trust in research and a growing gap between research and practice. In the field of educational technology, this has been particularly problematic given the significant resource costs, specifically time and economic, of implementing technology programs in schools.

Alignment issues and challenges

To address this issue in light of new learning and teaching paradigms, we argue that the concepts of 'sustainability' and 'scalability' need to be reconsidered to fully encompass and take advantage of new approaches and research opportunities for both: partnership in research; and digital change in educational organizations, teaching and learning. A key factor in being able to sustain or scale an innovation is being attentive to the context of the innovation and stakeholder needs (McKenney & Pareja Roblin, 2018). This is something that has been lacking in research. We argue that these terms need to be reconsidered to take advantage of new research approaches, such as machine learning, automation, analysis of digital behaviors, etc., to fully address scalability and sustainability in new learning and teaching paradigms. Purposeful decisions need to be made in collaboration with stakeholders to understand what is relevant and necessary for innovation in their learning spaces.

Specifically, core issues in this area have had challenges in identifying and understanding new paradigms in learning and teaching and coming to terms with features of new research approaches (Pachler & Turvey, 2018). First, the nature of ‘new paradigms’ in teaching and learning is difficult to generalize across contexts. This results in difficulty understanding what is new in one learning context and if that assumption holds in a second context. The idea of a new paradigm in learning and teaching has been under debate since the 1990s. In 1996 Reigeluth posed the question of ‘Do we need a new paradigm of ISD (instructional systems design)?’ (1996, p. 13). He also pointed out that the term ‘paradigm’ is ‘one of the most used (if least understood) words in the current vocabulary’ (Reigeluth, 1996, p. 13). He continued to argue this in 2013, proposing that learners should be the decision makers in instructional design (Reigeluth, 2013). As an example, while Reigeluth has posed this as a new paradigm, others may argue this approach had been used in classrooms for decades. We argue that the field is still struggling to come to terms with new paradigms of teaching and learning, particularly those integrating digital technologies. This lack of agreement and understanding complicates use and understanding of appropriate research method to investigate learning, teaching and digital technology integration to support change and innovation in new paradigms.

In particular, understanding of how to investigate sustainability of innovations or how to scale innovations across contexts is clouded, without a stronger understanding of the implications of new research approaches or the learning and teaching context (Curlova & Lukin, 2018; Penuel, 2019). Features of new research approaches and even what is a new research approach, like new paradigms, are relative to the context. However, it can be largely agreed that, in educational research, participatory research designs (e.g. Koenings, Bovill & Wooner, 2017), the use of big data and algorithms (e.g. Hofman, Jansen, De Mooij, Stevenson & van der Maas, 2018), networked and social learning (e.g. Voogt, Laferriere, Breuluex, Itow, Hickey & KcKenney, 2015), just to name a few, are often considered new approaches in research. This may also address the issue of understanding the possible risks and implications of new research approaches, specifically potential long-term and hidden effects of some research decisions, e.g. bias in data and assumptions of generalizability when scaling methods to new contexts. Ethical and governance procedures and policies are also needed to implement new research approaches in educational organizations.

In summary, we understand 'context' to be the most critical aspect of designing sustainable and scalable research, to investigate digital technologies in new learning and teaching paradigms. To research digital technologies in these spaces, it is essential to understand the learning and teaching paradigm and 'match' features of new approaches to research where appropriate to understand what works and for whom. Importantly, it is very difficult to make general claims and recommendations across a diverse range of possible contexts for learning. It is the hope of the group that our work provides an agenda for future research into new paradigms and approaches to research, and that others will join the effort to fill out the details through contribution of cases and insights from their contexts.

Possible actions to overcome misalignment

To better understand how research approaches can be used to investigate new paradigms of teaching and learning, the features of these approaches to support scalability and/or sustainability of technological innovation need to be made clear. However, it is also critical to understand that the functioning of this system is significantly affected by the hierarchical nature of education: policy, school leadership, teachers/instructors. These hierarchies comprise networks that connect people and policies on different levels (Penuel, 2019). Parts of this system are past programs and initiatives of digital technology innovation, and the efforts of those with power to affect change and guide the direction of schools and school districts. These power relationships have an ongoing impact on how individuals experience change initiatives, how they are able to engage in change, within set goals, strategies, and categorization of individuals (Bowker & Star, 1999). These power relationships need to be explored and 'inverted' to be able to initiate a more democratic change process, on that does not bring change and digital innovation to schools (e.g. top-down), but rather one that works with all stakeholders to identify appropriate change and innovation (e.g. bottom-up, participatory).

Moreover, it is essential that the features and research are understood in relation to the learning and teaching context, to be able to negotiate and design research. Figure 1 below outlines our work conceptualizing some of this process.

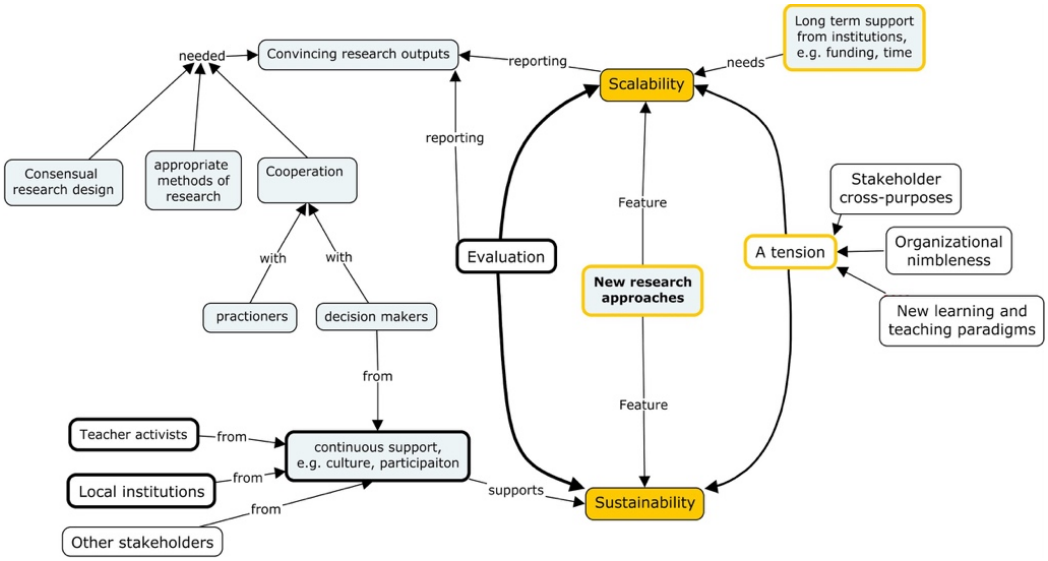

Figure 1 A framework to consider new approaches and paradigms for researching digital technologies

Key components of this process, which will address some of misalignments in this area could be:

- Understanding different stakeholder expectations of how new research outputs can inform technological innovation and the realities that new research approaches can actually produce.
- Addressing different stakeholder and researcher agendas in relation to the aims and goals of technological innovation in new research approaches and new paradigms of learning and teaching.
- Being realistic about data-informed practice and its limitations, such as data bias, data trust' and data ethics, to minimize 'backlashes' and risk aversion about data use.
- Ensure features of research approaches are able to support scalability and sustainability.
- Educational organizational culture should include the conditions necessary to support researcher and other stakeholder collaborations and participatory research within new learning and teaching paradigms.
- Collectively develop research outputs from new research approaches to support meaningful and relevant findings to support innovation and change in new learning and teaching paradigms.

Key insights from other TWGs

TWG10 consulted with two other thematic working groups, TWG2 and TWG6. With TWG2 "Learners as learning leaders," we discussed distributed leadership in the context of engaging with research and the nature of digital technologies to innovate teaching. It is possible also that a distributed model of leadership may be a good model to support participatory research, given that stakeholders would have a leadership role in the research and have ownership over their contributions. This could also be an approach for addressing power relations in hierarchies.

With TWG6 “Putting learning back into learning analytics” we explored the use of data and learning analytics as new research approaches and how they could inform sustainability and scalability. It is important to include students as stakeholders in the new learning paradigm and that they should be participants in data collection, analysis and interpretation. This would provide a rich contextual view into the context, through reflection of the real learning experience. This would improve the meaningfulness of data collected and the appropriateness of new research approaches in the context.

Strategies and actions

For new research approaches, such as machine learning, virtual reality, analysis of digital behaviors, to result in new knowledge that is sustainable and scalable across contexts, strong collaborative groups supporting the process are needed. This should include policy, researcher and educational stakeholders in order to understand what works for whom in which context. To this end, the following strategies are important:

Strategies and actions for policy makers

- Where possible key stakeholders should actively participate in research of technological innovations to support better understanding of new research approaches.
- Develop and implement funding schemes that foster long term collaboration between key stakeholders ([local] policy, research and practice).

Strategies and actions for practitioners

- Active participation in research and ‘championing’ research in the context, to create and support positive conditions of research and collaboration.

Strategies and actions for researchers

- Research is needed to identify how new research approaches are able to usefully inform sustainability and scalability of technological innovations, through continuous analysis and evaluation of what works for whom.
- Researchers need to consider new research approaches in concert with the needs of educational contexts, and in collaboration with stakeholders.
- Use of new approaches in digital technology research should be documented and disseminated to inform research and professional fields.

Collaborative strategies for all three

- Research designs should be the result of purposeful decisions among stakeholder groups regarding what will be scalable and what will be sustainable.
- Research designs need to incorporate how to permeate through to the pedagogical level and up to the level of policy to inform new paradigms of learning and teaching.

Finally, is essential that while we have designated particular strategies to stakeholder groups, these are in fact the responsibility of all stakeholders. Only by working across these groups and understanding what each set of participants contributes to the collaboration, is it possible to begin to dismantle the power relationships that can limit sustainability and scalability of new learning and teaching paradigms.

Actions from the TWG

Members of TWG10 will contribute to the special issue of Educational Technology Research & Design, to disseminate our work to the wider academic public. We will also attend academic conferences, such as EdMedia and the European Conference for Educational Research in 2020, to participate in EDUsummIT symposia. However, we will also disseminate to professional publications, such as the Australian SCAN magazine and TechTrends. This is an effort to reach practitioners and policy makers, in local contexts. Group members will also, where possible, embed some of these approaches in their own research designs. This process will be documented and tracked to understand if there are affects from this approach in the project.

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Thematic Working Group 11
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Cross-Cultural Alignments, Fertilization, Differentiation: Bridging the Gaps through Technology

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Introduction

Members of this group started to work asynchronously four months before the meeting in Quebec to produce the working document. During the three days of the Quebec EDUsummIT we were able to concentrate and discuss the connection and the tension between culture and technology and produce TWG11's contribution to EDUsummIT2019's Action Agenda for Advances in Education. Following the summit, we continued to work on a Google doc as well as a weekly meeting via ZOOM with three to four members each time. Those meeting collaborated to produce this manuscript. We defined the terms, summarized alignment issues and suggested strategies and actions for policy makers, practitioners and researchers.

Figure 1 TWG11's participants in Quebec - EDUsummIT 2019

Background

The founder of the European Community, Jean Monnet, once declared "If I were again facing the challenge to integrate Europe, I would probably start with culture." Culture is the context in which things happen in societies, institutions and organizations. However, culture is not easily defined because it is largely implicit. The concept of culture which Boas (1930, p. 30) defined as the "social habits of a community," and Smith and Bond (1998, p. 69) as "systems of shared meaning" or more simply by Deal and Kennedy (1983, p. 14) as "the way we do things around here" illustrate the depth, power, reach and hidden complexity of culture and its accompanying artefacts and constructs.

In their attempts to describe culture, scholars have likened it to an iceberg or an onion where the outer layer comprises a cultures' explicit or visible manifestations such as nationality, race, religion, language, heritage, etc.; a deeper, middle layer includes norms and values that guide a group's or individual's actions based on a shared understanding of what is right and wrong, good and bad and how one should behave and conduct oneself; and finally the deepest and least understood inner core made up of what Schein (1992, p. 12) calls "basic underlying assumptions," which manifested in the members' unconscious, taken-for-granted beliefs, which are the ultimate source of their values and actions. The power of culture Schein argues, comes from the fact that these assumptions are shared and mutually reinforced, therefore, to understand culture one has to be able to examine all three levels, for it is only by understanding levels one and two that one can unlock the door to the most fundamental level, its basic Assumptions.

In the digital era when globalization and migration form part of the educational landscape, understanding culture and appreciation of its role in the learning process is paramount. It can be argued that digital technologies represent a two-edged sword that may contribute to either the destruction or the revitalization of cultures. Media and related technologies have contributed to the loss of culture and languages. This trend underscores the importance of language awareness across the globe (Resta, Shonfeld, Yazbak Abu Ahmad & Wallace, 2018). Furthermore, as McLoughlin and Oliver (2000, p.58) note, the "acceptance, use and impact of websites are affected by the cultural backgrounds, values and needs of learners," while Collis (1999) argues that designers need to consider learners' cultural backgrounds when designing computer-based learning environments because culture shapes learners' values, perceptions and goals and determines how they respond to computer-based learning.

Although the Internet has contributed to globalization and the homogenization of culture, it also provides new opportunities for the revitalization of culture and for fostering cross-cultural understanding. The assumption that culture influences learning and that we need to design learning environments which are culturally inclusive and accommodate the needs of students from different cultural backgrounds has been part of the thinking behind the push for multicultural education policies that were introduced into Australia beginning in the 1970s (Lal, 2002). In recent years, the use of online projects providing opportunities for collaborative learning in a multi-cultural environment, even between hostile cultures, has been increasing. Information and communication technologies (ICT) serve as a significant lever for learning, with affordances for various teaching and learning approaches. The digital environment enables the formation of heterogeneous groups that were not possible in the past due to physical limitations. Such an environment creates opportunities for students from different

cultures and countries to interact and learn together. It allows for the formation of relationships without the influence of stereotypes that may arise from external appearances and can even contribute more successfully to cross-cultural understanding than a face-to-face intercultural meeting. Among the projects that use ICT to connect cultures are TEC (Technology, Education and Cultural diversity); The Dissolving Boundaries Program; NASA's STEM Innovation Lab; The Four Directions Project; Research Project – Culturally responsive use of ICT to support indigenous-students' learning; Africa Digital Schools [BADILIKO] project; The LOCH project; and the Micool (Mobile Intercultural Cooperative Learning) Project (Shonfeld et, al., 2019).

These and other online collaborative projects illustrate how digital technology can connect students to other cultures through problem-solving activities and shared thinking which offer students the opportunity to explore their own rights and those of others; identify their own abilities and values and the differences between themselves and others in their classrooms as well as students from other countries and traditions. The process of interaction with other students, as they work together on a project, exposes the students to the diverse abilities, cultures and traditions of other learners. By working on a common goal, learning takes place. Multiple input is encouraged in classrooms involving digital cross-cultural learning. Through digital learning, the interaction is active and engaging for children learning with children from other cultures, providing them with an exciting educational environment. As Wardle (2008) argues, "Diversity cannot be taught directly, it is not a curriculum, it is not a lesson plan, it is not just celebrating ethnic holidays in the classroom." True digital learning provides the opportunity for immersion into the core of diversity, thus enabling students to come to grips with underlying basic assumptions that shape culture. Importantly, is not a teacher-centered process, but a learner-driven process involving interaction with other learners. The advantage of digital cross-cultural learning is that "the student is motivated to attend class, be engaged, and to learn. The advantage of "information technologies are… [the creation of] new possibilities for new services and products, contributing towards acceleration in the pace of social, technical, cultural, and economic change" (Field, 2004) for countries.

Alignment issues and challenges

The composition of classrooms is becoming increasingly diverse in terms of students' culture, language, and abilities. In order to meet the needs of all students, teachers need to have more awareness of and ability to cater for these diverse individual and collective needs (Richards, Brown & Forde, 2007).

Our working group identified several issues and challenges below.

- Characteristics of learners and educators
- Individual, social and cultural differences between learners
- Language differences
- Awareness of cultural diversity of learners
- Different values of learning in different societies

Possible actions to overcome misalignment

- For teachers to be able to effectively cater the cultural diversity of the students in their classroom, they need to be supported through professional learning and development to adopt and use culturally responsive pedagogy (Richards, Brown & Forde, 2007). Teachers need to be able to provide, confidently and competently, classroom environments where all students are valued and have their culture, language and abilities supported.
- Promoting Social justice orientation in education
- External human resources to help teachers in class
- Curriculum designed for majority population, not for minorities
  Online spaces and curricula designed for majority groups lead to the marginalization of learners from minority groups. Teaching and learning spaces and experiences should recognize the ways in which social locations, cultures and languages shape meanings, experiences and learning. We advocate for co-constructing curriculum with youth, teachers and leaders from minority groups, thereby recognizing them as agents of change whose voices need influence and shape online learning spaces.
- Digital disruption is defined when
  "… the change that occurs when new digital technologies and business models affect the value proposition of existing goods and services. The rapid increase in the use of mobile devices for personal use and work, a shift sometimes referred to as the consumerization of IT, has increased the potential for digital disruption across many industries." (TechTarget, n.d.)
- Top-down decisions
- Cultural barriers (religion, ethics, language)
- Digital divides (access; competence/skills)
  Technology in education could be a powerful lever for social change, but important divides in relation to access to reliable, affordable Internet connections and digital tools are notable. Moreover, digital skills divides have been documented in diverse communities globally, and even identified as a significant, complex social and economic problem by many scholars with diverse disciplinary and theoretical orientations. We therefore advocate building pathways for digital literacies learning that can bridge these skill divides and empower all learners, across majority and minority groups, to create an Internet that includes and reflects their identities, and includes their voices, perspectives and priorities.
- Digital culture (influenced by American/majority culture)
- Social/political structures that limit access and information
  Notwithstanding the clear and proven benefits of cross-cultural projects described in the introduction, impediments imposed by certain state actors can greatly limit the possibility of organizing cross-cultural projects that would benefit students in their own countries as well as students in neighboring countries and/or from different cultural backgrounds. These impediments can include restrictions on using the Internet to connect with students outside the country as well as censorship of content and, finally, a not-unfounded fear that communications between culturally-diverse groups will be monitored by state actors, thus significantly reducing the level of open dialogue.

Key insights from other TWGs

TWG 12 suggests a collaborative work on curriculum (Butler & Twining, 2019). To establish a sustained committee for international education, it must include policymakers, practitioners, and researchers from diverse cultural backgrounds. Developing a Pedagogy of Plenty in classrooms requires all the stakeholders to work together. Pedagogy of Plenty is an extension of the Paulo Freire's work on the Pedagogy of Oppressed. Freire (2002) said, "Education must begin with the solution of the teacher-student contradiction, by reconciling the poles of the contradiction so that both are simultaneously teachers and students. Thus, our recommendation to co-construct the curriculum by all the partners."

Strategies and actions

Recommendations are based on group work at the EDUsummIT and on participants research and literature.

Strategies and actions for policy makers

Local: State / Provincial / Regional

- Ministries of Education, at sub-national and national levels, should include traditionally under-represented groups as active participants during curriculum design and development meetings.

National

- National governments should adequately fund, on a long-term basis, the design and development of curriculum that represent the values of traditionally under-represented groups (Beatty & Blair, 2015)
- National governments should encourage communication and collaboration between heterogeneous groups within their countries by establishing inexpensive educational projects that make use of the Internet to break down perceived barriers between these groups.
- Higher education and teacher education programs should lead online collaborative projects such as the (TEC) technology, education and cultural diversity model (Shonfeld, 2017).
- Education programs "that serve underrepresented groups, stakeholders in both the public and private sector should, when feasible and permissible by law, report participation statistics in a public and transparent way." (Science and Technology Council, 2018, p.36)

International

- On a global level, organizations such as UNESCO should inform and encourage member organizations of "best practices" in reference to the inclusion of traditionally under-represented groups in the design and development of national curriculums. (UNESCO SDG4)
- In addition, UNESCO, and/or large foundations, could manage and fund inexpensive collaborative educational projects that make use of the Internet to break down perceived barriers between cross-border heterogeneous groups.

Strategies and actions for practitioners

- Teachers should create opportunities to connect the classroom curriculum with students' and their communities' lived experiences beyond school.
- Teachers and students need to create and inclusive and respectful classroom culture that welcomes and responds to the diverse knowledge and experiences they bring to the classroom.
- Culturally responsive classrooms should support diverse ways for students to develop, express and share a cumulative understanding of curriculum and knowledge.
- Culturally responsive teachers, at times, need to position themselves as learners so that students, their families and communities can contribute to their expertise.
- Teachers need to learn about their students and their culture to address their diverse needs.
- Teachers should be trained how to develop empathy skills.
- Teachers should use media that positively depict a range of cultures.
- Classrooms should adopt peer teaching (tuakana/teina)
- Classrooms and online spaces should be open to students' language(s) to better reflect their identities, cultures, experiences and knowledge.
- Digital literacies workshops should be developed with and for students as well as parents, community members and teachers to close digital-skills divides.

Strategies and actions for researchers

- Provide the basic foundations: social justice; lifelong learning; well-being; quality educational
- standards; lifelong learning; and cross-cultural well-being.
- Take care to provide learners with intercultural competencies, collaboration skills and digital literacy
- Provide international infrastructures for cross-cultural learning, including funds, ongoing support and pedagogy informed by research
- Form a sustained international committee for international education that will include policymakers, practitioners and researchers from diverse cultural backgrounds
- Encourage and support teachers in working online with a diverse student population.
- Co-construct the curriculum by all the partners (learners, policymakers, practitioners, researchers)
- Policymakers and practitioners should follow the CCA model, and researchers should examine the model and validate it by empirical studies.

Actions from the TWG

TWG 11 will continue to disseminate their findings and manuscripts at various venues:

1. Global Education Conference on November 19, 2019. https://www.globaleducationconference.org/page/2019conference
2. SpeedTech- Dec 5, 2019- https://www.nyit.edu/events/speedtech_fall_2019_conference
3. SITE conference April 6th,- https://site.aace.org/conf/
4. Edmedia June 1st-June 5th. http://www.aace.org/conf/edmedia/
5. Tec international day March 18th (to be published in: tec.macam.ac.il)

6. IAIE in Israel June 2021 – (to be published in: iaie.macam.ac.il)

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Thematic Working Group 12
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National Policies in Curriculum Reforms: What Makes a Quality Curriculum in a Technological Era?

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Introduction

We live in a rapidly changing technological world, with a range of demographic and environmental challenges (OECD 2018). Emerging technologies challenge traditional learning, teaching and assessment processes. Many countries are reforming (parts of) their curricula in an effort to reflect these challenges. Pre EDUsummIT, discussions of Thematic Working Group 12 (TWG12) focused on what makes a quality curriculum in a technological era. These discussions considered what the purposes of education systems should be in a rapidly changing world, and thus what educational visions, policies and practices might be most appropriate (Butler et al. 2018). In addition, the group members considered:

a. What knowledge, skills, attitudes and values will today's students need to thrive and shape their world? (e.g. see Erstad & Voogt 2018)
b. How can instructional systems develop these knowledge, skills, attitudes and values effectively? (e.g. OECD, 2018).

This work highlighted existing tensions within many national education systems including:

- using technology to enhance existing curriculum subjects;
- the need to educate next generations of workers to adapt to a rapidly changing world;
- the contrast between the rhetoric of policy documents and actual classroom practice in many countries. Even where reform has taken place at curriculum level, it has not always translated into concerted action at the classroom level.

At EDUsummIT 2017, TWG1 (http://unesco.unibit.bg/en/TWG1) examined the issue of alignment in education (see Butler et al 2018). Building on this work in 2019 TWG12 focused on the complexity of translating policy into practice and in particular, the misalignment across and between the various levels of individual national education systems (see Figure 1).

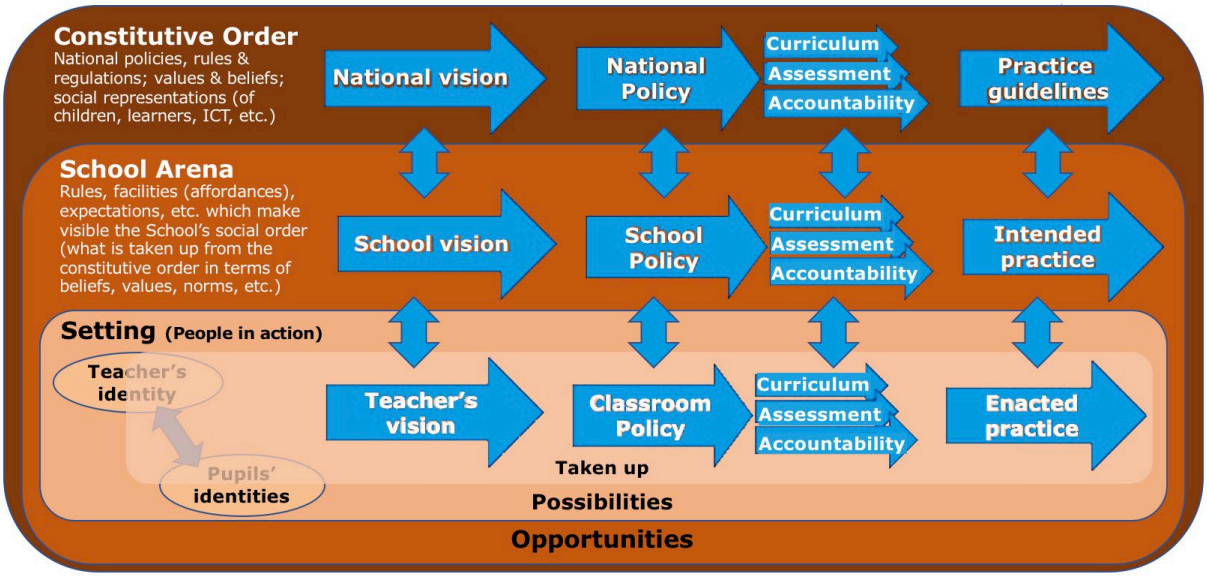

Figure 1 Alignment within and across levels (Twining 2018a)

Alignment issues and challenges

The complexity of alignment in education is illustrated in Figure 1, which is based on a sociocultural framework that highlights the importance of three levels of analysis:

- The constitutive order – the broader context, including cultural norms, values and beliefs, as well as more explicit policies, rules and regulations. This includes any nationally specified curriculum.
- The arena – the enduring elements of the school context which are taken up from the constitutive order. For example, how policies and expectations at the national level are interpreted and enshrined in the school expectations, policies and facilities. This includes any school specified curriculum (e.g. school schemes of work).
- The setting – the local context (e.g. the classroom) in which practice is implemented. At this level of analysis, the actors (e.g. teacher and students) perceive what is possible within the context of the school arena in the light of their identities. They 'take up' some of those perceived possibilities in their iterative interactions with the other people in their setting (resulting in the enacted and experienced curricula).

Cognizant of the complexity of alignment at the macro, meso and micro level, TWG12 discussed the appropriateness of using the Educational Vision and Mission Framework (EVMF, Butler et al. 2018) as a starting point for reflecting on what should be considered for inclusion in a quality curriculum for the technological era. The EVMF includes two key elements:

- A vision statement (Individual fulfilment and Universal wellbeing) which aims to capture the inter-related needs of individuals and society
- A statement of key curriculum areas that need to be addressed in order to achieve the objectives in the vision statement in the context of a world in which the only certainty is change and uncertainty.

There was general agreement within TWG12 about the overarching vision and the key elements identified within the curriculum framework (see Figure 2), which highlights the importance of addressing content ('knowledge') and skills, as well as values and personal

attributes (e.g. empathy, resilience, openness). However, TWG12 members agreed that an essential element of achieving alignment is the need for all stakeholders to be involved in collaboratively co-constructing the curriculum – thus it was felt that it would be inappropriate for TWG12 to do more than provide the overarching curriculum framework (Figure 2) as a starting point for stakeholder discussions.

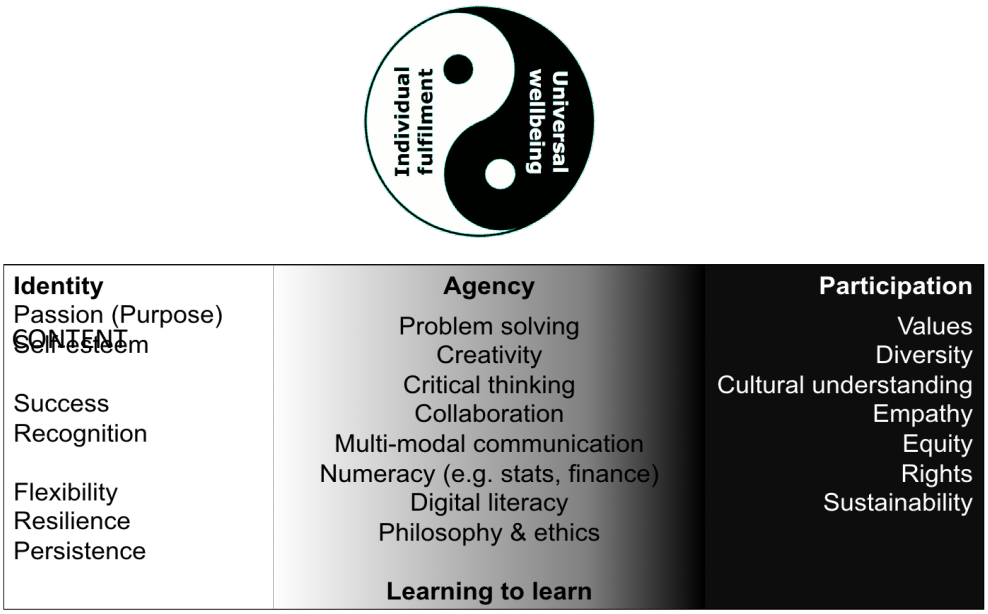

Figure 2 The Vision and Curriculum Framework (based on Twining 2019a)

TWG12 also agreed that in addition to the curriculum framework it was critical that all levels of alignment were considered in a coordinated and coherent manner for quality curriculum reform to be successful (c.f. Figure 3). To show the difference between the constitutive order, school arena and the setting with regard to curriculum reform, the curriculum representations (intended curriculum, expected curriculum, enacted curriculum and experienced curriculum) were added to emphasize the need for alignment within and across levels.

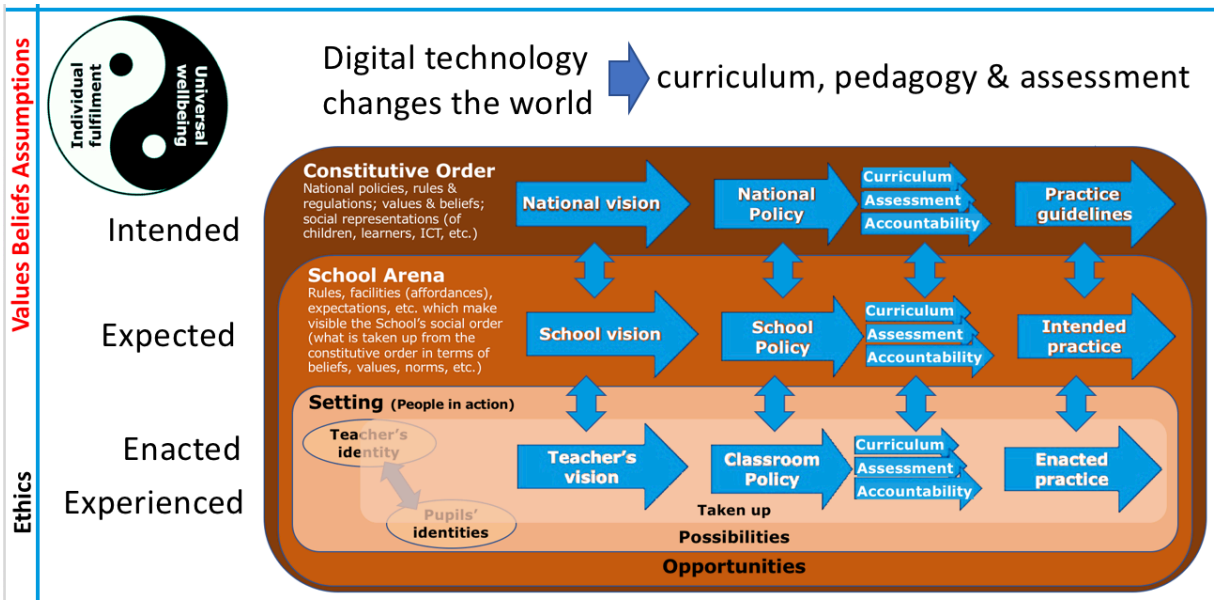

Figure 3 Levels of alignment to be considered in a coordinated and coherent way for curriculum reform

The group discussions thus focused on three core issues which were viewed as paramount when developing national policies to ensure quality curriculum in a technological era: partnership with curriculum stakeholders; teacher professionalism; and summative assessment.

Partnership with stakeholders

Traditionally, curriculum reform has been a top-down process that may only reflect the concerns and interests of an exclusive group of stakeholders (e.g. policy makers). Often the concerns of other stakeholders in education including students, parents, teachers, commercial companies, and NGOs are not considered. While the process of curriculum development may sometimes appear to include broad consultation, this can be limited or tokenistic with a lack of feedback to inform stakeholders how the consultation process informed the curriculum design (e.g. 'Computing' in England (Williamson 2017)). This lack of transparency may result in disengaged stakeholder groups, cynicism and lack of trust in policy and processes.

Teacher Professionalism

While it is well understood that school leaders must intentionally create opportunities for teachers to collaborate meaningfully in curriculum change (OECD, 2019), in many countries teaching has been de-professionalized (Fitzgerald, 2008; Rubin, 2011; Rubtkova et al, 2015). This is reflected in the fact that teachers are often not fully engaged in the consultation process when decisions are made in relation to curriculum (e.g. Elliott, 1994; Williamson, 2017). This is a self-fulfilling cycle - the less teachers are involved in the development of national curricula the less expert they become at curriculum development, which in turn increases the perception of lack of professional expertise and reduces the likelihood that they will be asked to contribute to curriculum development in the future.

Summative Assessment

It is widely recognized that summative assessment drives practice in schools (e.g. ETAG 2016) and it is clear that curriculum, pedagogy and assessment are intimately linked (Wyse, Hayward & Pandya 2015). Thus, any attempt to define 'a quality curriculum' without simultaneously addressing pedagogy and summative assessment are likely to be counter-productive.

Changing the culture of summative assessment practices can often be a point of resistance by parents, teachers and policy makers (Thrupp, 2018; Tolley, 2009). This raises the question of the purpose of summative assessment; who it is for and how it is used. In many jurisdictions summative assessment is as much to do with determining the quality of the school (e.g. league tables in England) or education system (e.g. international rankings based on PISA) as it is about establishing what students have learnt. This skews practice, for example leading to schools 'off-rolling' students (Bradbury 2018), focusing additional support on students who are perceived as performing at a level just below a grade boundary, and/or restricting students' subject choices (Barrance & Elwood 2018). We need to change the ways in which summative assessments are implemented and used to avoid this gaming of the system.

In addition, traditional approaches to summative assessment (e.g. paper-based exams) are unable to capture many skills and attributes that are frequently cited as being critical today. Not unreasonably, teachers tend to focus on those things for which they are held accountable

- predominantly high stakes test results. In practice, this means that they continue to focus on teaching 'content' rather than focusing on developing these critical skills and attributes. We need to develop new forms of assessment that can 'capture' evidence of the things that matter rather than just the things that it is easy to assess. This raises many challenges as well as opportunities (Webb & Ifenthaler 2018).

Unless solutions are found to these assessment problems, the gap between the rhetoric of national curricula and the reality of practice in schools will remain.

Possible actions to overcome misalignment

Partnership with stakeholders

Curriculum development and reform needs to be:

- undertaken within a robust framework for meaningful ongoing consultation so that all stakeholders (students, parents, teachers, policy makers, companies, NGOs, and other stakeholders) have a voice in the reform process;
- seen as an iterative process – for example as was evident in the recent curriculum reform process in the Netherlands that entailed six loops of consultation (Fisser & Strijker 2019);
- informed by research in which the curriculum is collaborative co-constructed (envisioned and designed) with all stakeholders.

Stakeholder engagement needs to be core to each cycle of the reform practice to ensure not just 'buy in' to the resultant curriculum, but ownership of it by all relevant parties (and in particular those who have to implement it). This requires transparency about decisions that are made and a pro-active approach to addressing power imbalances between and within different stakeholder groups.

Valuing the expertise of teachers is central to this endeavor, as well as to the enhancement of teacher professionalism (Würzburg, 2010).

Teacher Professionalism

Raising the status of teachers and teaching as a profession is pivotal as "the quality of an education system cannot exceed the quality of its teachers" (Barber & Mourshed, 2007 p.40). Where not already in place, steps need to be taken to ensure that:

- all teachers undertake high quality initial teacher education
- practicing teachers are involved in continuously updating their expertise (for example through engaging in practitioner research and/or further study/professional learning)
- there is an independent professional body that oversees professional standards

In addition, education policy needs to be de-coupled from the short-term concerns of politicians (Würzburg, 2010) as has happened, for example, in Finland (Finnish National Board of Education, 2016).

Summative Assessment

Official, state-mandated exams take time away from learning, and their results are not reinvested in learning as feedback. They would be better used as indicators to steer the system than as assessment of individual students, while individual assessments should be the result of the teacher's professional judgment (Conseil supérieur de l'éducation, 2018). Where assessment is being used to judge the quality of provision, then rather than assessing all students every year sampling should be used. In the Canadian province of Ontario provincial large-scale assessments are used to take a snapshot of the strengths and weaknesses of the education system (Ontario Ministry of Education, 2010, p. 92). In addition, individual results should be kept confidential – with aggregated data being used to evaluate the quality of schooling.

Digital technology potentially offers new ways to capture data about learning. Adaptive systems can be used both formatively to adjust students' learning pathways, and also to provide summative data as a by-product of that process. Technology enabled assessment offers the potential to capture evidence about a wider range of skills and attributes than traditional paper based exams (or multiple choice assessments) (ETAG 2016).

Artificial intelligence (AI) and in particular data mining techniques offer the potential to infer knowledge, skills and attributes from students' digital footprints. For example, it would be possible to analyze data about how a student engaged with an environment like Minecraft, overcoming obstacles, interacting with other participants and achieving their goals (Twining 2019b).

Digital technology can also support new forms of formative assessment. For example, research suggests that new technologies can enable teachers to "individualize feedback, increase student engagement, collect learning evidence for all students, facilitate reflective processes, and support self-regulated learning." (Van der Kleij and Adie, 2018, p.612).

Key insights from other TWGs

TWG12 had discussions with three other working groups.

TWG13 Knowledge building/creation

The theoretical and pedagogical underpinnings of knowledge building align well with the aspects of curriculum highlighted by TWG12 (see Figure 2) and our approach to achieving alignment through co-construction of the curriculum. TWG13 noted that members of their group had had some success in developing teacher professional learning communities. However, such initiatives which start as funded projects tend not to be sustained once the project funding has ended.

TWG13 suggested that one could assess learning within a knowledge building community by analyzing the linguistic sophistication of their work. However, they highlighted the tension that exists between assessment of a community and the desire within our education system (and from parents) to assess individual children. Social network analysis may help to address this challenge.

TWG8 Pedagogical reasoning

Pedagogical reasoning is a critical component of teacher professionalism (Shulman, 1986). TWG8 focused on pedagogical reasoning related to the use of digital technology in schools. They argued that teachers who understood how digital technology could be used effectively in schools could/should inform the design of curricula and could act as change agents to enhance digital technology use in education. Good pedagogical reasoning, they argued, would change the role of the teacher from sage on the stage to guide on the side.

TWG6 Learning analytics

Traditional learning analytics focusses on what might be categorized as 'managerial' or 'diagnostic' aspects of education – highlighting when students are not engaging or are getting poor grades and an intervention might be necessary to help them successfully complete their studies. The field of Social Learning Analytics focusses on assessing students' learning. We need to move beyond gathering behavioral data within learning management systems to actually capturing evidence of learning.

TWG6 suggested that most work on analytics for assessment was taking place in the field of serious games. Perhaps this is the area that will be most critical for enhancing learning in a digital world.

Strategies and actions

Strategies and actions for policy makers

- Decouple education policy from short political timeframes
- Provide support for initial and ongoing teacher education
- Ensure education policy development is owned by key stakeholders
- Ensure alignment between policies at the National Level (e.g. curriculum, assessment, and pedagogical guidelines)
- Where using assessment to gauge the quality of educational provision use sampling techniques and ensure that individual student results remain confidential

Strategies and actions for practitioners

- Where possible school leaders should ensure alignment of curriculum and assessment at the school level
- School leaders should encourage a culture of professional dialogue and debate about curriculum and the purposes of assessment in their school
- Practitioners should ensure that they are clear about the intended purposes of their school curriculum and assessments
- Practitioners should actively engage in continuous reflective practice and communities of practice as part of your own going professional learning
- Practitioners should engage in practitioner research – learning from and contributing to the professional knowledge base
- Practitioners should view themselves as curriculum designers and not merely curriculum deliverers – they should contribute to curriculum consultations

Strategies and actions for researchers

- Support teachers as practitioner researchers
- Research new forms of assessment
- Engage with policy makers
- Disseminate research findings in appropriate forms for teachers, policy makers, parents and other stakeholder
- Engage in policy consultations

Actions from the TWG

- Extend the TWG12 EDUsummIT discussions at conferences including:
  - Mumbai (Deirdre & Margaret)
  - ICET – International Council for the Education of Teachers (Chris)
  - The annual conference of the Society for Information Technology and Teacher Education (SITE) (Petra)
- Contribute to publications, informed by TWG12's discussions, including:
  - Contribute to the journal article for ETR&D
  - Dutch publication in Didactief (https://didactiefonline.nl/) a magazine for schools
  - Write a report destined to the Ministry for Education in Quebec including TWG12 reflections (due in 2020)
  - Tweet and blog about the outcomes from our group
- Embed opportunities to think about curriculum purposes and alignment in initial teacher education and professional learning courses offered by their institutions
- Research new forms of assessment (e.g. the use of Point of Learning (PoL) as a new form of assessment in secondary schools (Twining 2018b)).
- Actively engage in curriculum reform at national level

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Thematic Working Group 13
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Knowledge Building/Knowledge Creation in the Classroom, School, and Beyond

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Introduction

Knowledge Building is a prominent research theme in the learning sciences including computer-supported collaborative learning (Yoon & Hmelo-Silver, 2017). Supported by Knowledge Forum®, educators, researchers and engineers work to transform classrooms into Knowledge-Building communities developing students' technology literacy, deep understanding and knowledge-creation competencies through three key educational goals highlighted in the UNESCO ICT framework for teachers (2011). OECD's PISA (2017) has recently evaluated students' collaborative problem-solving and creative thinking, two areas related to Knowledge Building. TWG13 examined how Knowledge Building can be aligned with future-oriented educational models of technology-supported pedagogy, as well as local and regional educational policies. Before the EDUsummIT meeting, members identified key questions and challenges (http://bit.ly/2vkQYHg), reviewed relevant data and literature, and created a Knowledge Forum database to sustain discussions surrounding theoretical and practical issues to be addressed at the summit as shown in Figure 1. The pre-meeting discussion paper (http://bit.ly/38ugkks), EDUsummIT presentation, 2-page document (http://bit.ly/2tOL3tJ) and e-book chapter are the collective work of TWG13. In this chapter, we first consider why knowledge creation is an imperative in education and then introduce the Knowledge Building model and Knowledge Forum (Scardamalia & Bereiter, 2014). We propose a framework addressing misalignments through Knowledge Building and discuss strategic actions and synergetic alignments with other TWGs for advancing knowledge creation in education.

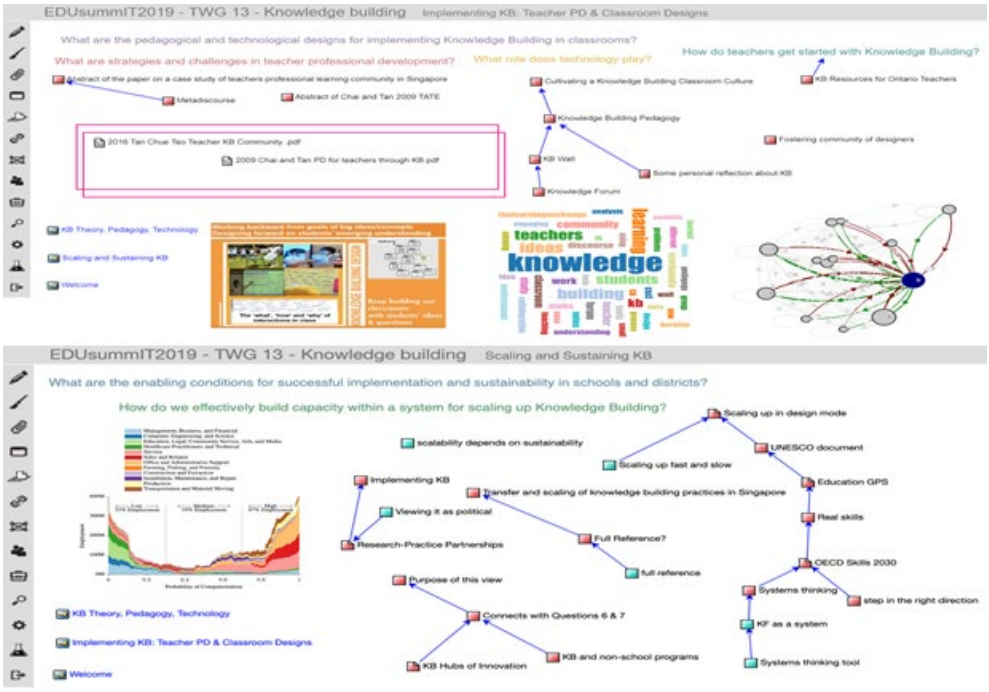

Figure 1 TWG13 Knowledge Forum database created for sustaining EDUsummIT discussion

Globalization, exponential growth in technology, and knowledge economies have brought unprecedented changes requiring new models to help learners adapt to increasingly complex demands throughout all sectors of society. Many societies today are characterized as "knowledge societies" (UNESCO, 2005) where the creation, dissemination, and utilization of knowledge have become central to the prosperity and advancement of nations. There is growing recognition that schools need to go beyond lifelong learning and promote a culture of creativity and innovation (Pellegrino & Hilton, 2012). Preparing students to engage in knowledge creation is critical for effective community and social engagement, participatory democracy, and social progress (OECD, 2015).

While knowledge creation is critical to societal progress and collective well-being, a common belief holds that few can create new ideas. The traditional "genius" conception serves to increase existing gaps between the knowledge rich and poor, and, in turn, undermine society's natural, abundant, untapped resource—the ideas of its citizens. A modern theory of knowledge creation is needed if we are to foster a vision of an inclusive knowledge society. How knowledge creation can be realized in classrooms, schools, and beyond, supported by digital technologies for new educational alignments has become an urgent educational agenda.

The Knowledge Building (KB) model, supported by Knowledge Forum (KF) technology, is an educational approach that aims to bring knowledge creation into schools by the most direct means possible—by *engaging students in the actual work of a knowledge society* (Scardamalia & Bereiter, 2006; 2014). Knowledge Building, first developed at the University of Toronto (Scardamalia & Bereiter, 2010), has been defined as a community's effort to advance the state of knowledge through collective cognitive responsibility (Bereiter, 2002; Scardamalia & Bereiter, 2014). Through Knowledge Building practices and Knowledge Forum technology, students work together in rich multimedia environments featuring different ways for

everyone to contribute to and build on others' ideas, locally and globally. Knowledge Forum's embedded multi-level and multi-modal analytic tools provide real-time formative and transformative feedback to support participants' continual knowledge advancement, and a set of twelve principles guide researchers and educators in transforming classrooms into Knowledge-Building communities (Scardamalia, 2002).

Central to Knowledge Building is Knowledge Forum (Scardamalia & Bereiter, 2014) an online networked platform optimized for creative and collaborative knowledge work. Students can contribute their ideas as multimedia objects (e.g., notes, drawings, diagrams, attachments, audio/video clips) into community spaces called 'views' (Figure 2a) for others to build on, cite, and refine. The note editor (Figure 2b) includes "scaffolds" that are epistemic markers (i.e., I need to understand, my theory, this theory cannot explain, new information, putting our knowledge together) to support theory building, progressive problem solving, and collective knowledge advancement. Embedded analytic tools help students sustain their knowledge work through interactive visualizations that illuminate the evolution of community knowledge and interaction dynamics over time. The word cloud (Figure 2c), social network analysis (Figure 2d), and scaffold growth (Figure 2e), are among a suite of assessment tools. Knowledge Building and Knowledge Forum is used in K-12 classrooms and beyond, including postsecondary education as well as professional learning contexts (Chen & Hong, 2016; Bereiter & Scardamalia, 2010; Chan & Yang, 2018; Tan, 2018).

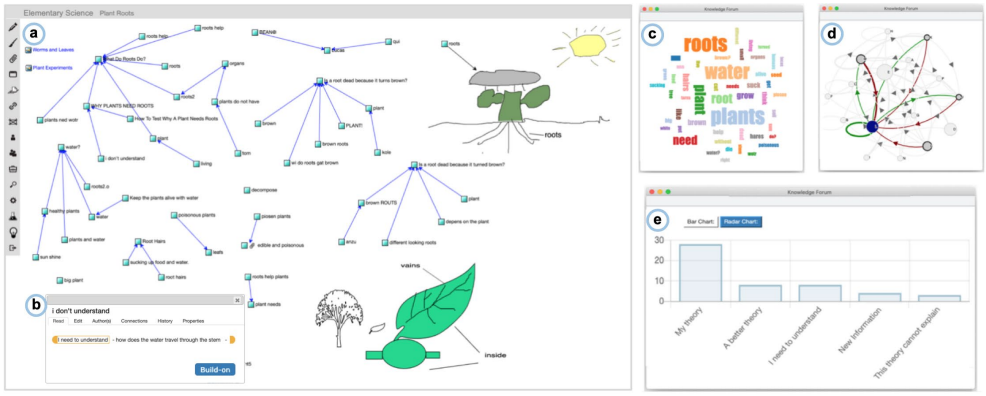

Figure 2 a) A typical view in Knowledge Forum with graphics, build on notes, links to other views; b) scaffolds for note writing, and analytics tools including c) word cloud, d) social network analysis, and e) scaffold growth

Alignment issues and challenges

Although knowledge creation is increasingly emphasized in education and incorporated in major educational documents (see UNESCO, 2011), many tensions/gaps remain regarding how it should be addressed in education policies, enacted in school/classroom practices, and cultivated among students, teachers, and other educational stakeholders. Professed new educational goals and practices – e.g., developing 21st century skills and incorporating new pedagogies and technologies – are often piecemeal and ad-hoc changes resulting in 'shallow constructivism' in classrooms (Scardamalia & Bereiter, 2014). Misalignments are prevalent in schooling for knowledge creation and we discuss the Knowledge Building (KB) approach to developing emerging new alignments (Table 1).

Table 1 School and policy practice misaligned with education for knowledge creation and emerging realignments enabled through Knowledge Building

Misalignments with Knowledge Creation	Emerging Realignments through Knowledge Building
Views of Learning and Knowledge	
Gaps between professed educational goals and prevalent views of learning create tensions. The creation of new knowledge is prized and understood to involve teamwork, but reserved for a few, with learning treated as individualistic and knowledge as immutable.	KB engages students in collective creative, collaborative work with ideas to advance and to transform community knowledge. KB is dynamic and part of a cultural effort engaging all students for sustained idea improvement through collective responsibility.
Development of 21st Century Skills	
21st century learning is advocated, but the focus is often on mastering discrete skills as add-ons to the core curriculum, with knowledge-skill bifurcation.	KB goes beyond 21st century skills –competence emerges from student engagement in authentic knowledge-creation contexts.
Equity and Education for All	
Education for all is a professed goal but it is commonly believed that knowledge creation is for "high achievers"; this belief is reified in classroom activities.	KB as knowledge creation is for everyone – all students can contribute/improve ideas supported by technology and community dynamics.
Curriculum, Learning and Assessment	
Separation in curriculum, learning and assessment: collaborative learning activities in classroom are disconnected from assessment that continues to emphasize individual-based achievement.	KB assessment illuminates learning and collaboration as it proceeds; embedded, concurrent, transformative assessment is supported by Knowledge Forum collaborative technology and analytics.
Pedagogy and Technology	
Piecemeal approach to new technologies and pedagogies -- generic digital tools and new pedagogies are add-ons, increasing work and to-do lists and favouring instructional procedures over principles.	KB digital technologies optimized for knowledge creation; principle-based pedagogy for emergence of knowledge creation and student agency; pervasive change in classroom culture.
Teacher Professional Development	
Professional learning is viewed as acquiring "best practices" from experts—often reflected in "one-and-done" workshops; pedagogy for improving learning is a process of individual change.	KB teacher professional development mirrors knowledge-creation processes fostered at all levels; thus teachers work collectively to progressively improve pedagogical designs for collective knowledge building.
School Policy	
Policy and practice for innovation is often fragmented, with calls for change but limited support and different levels of the enterprise focusing on separate parts.	KB views change as based on the systemic and holistic integration of research, practice, technologies toward progressive improvement – different stakeholders work collectively as a Knowledge Building community.

Introducing new pedagogies and technologies in piecemeal ways create disruptions that may compound, rather than address the misalignments. As with any educational innovation, it is critical to adopt evidence-based and *integrated* approaches that address the multiple levels of complexity in systems with change grounded in classroom and school practice. Knowledge

Building offers a holistic integration of theory, pedagogy, and technology to enculturate students into authentic knowledge work, with evidence on students' developing capacities for knowledge creation, and learning outcomes across subjects and levels (Chen & Hong, 2016). A central principle of Knowledge Building is progressive improvement – gaps and misalignments in educational change for knowledge creation can be addressed through progressive refinements and continual change. Research on school and teacher development (Chan, 2011; Laferrière et al., 2010), along with global innovation networks in Knowledge Building (Hong, Scardamalia & Zhang, 2016) has demonstrated new combinations and alignments of pedagogy and technology and interdisciplinary knowledge practices in different national educational systems.

Key insights from other TWGs

There are many connections among TWG13 and other working groups, and we highlight several in the hope of developing deeper understanding and mutually-reinforcing alignments for systemic change.

- *Student leadership and agency*: Knowledge Building engages students as *epistemic agents*, generating and contributing ideas through progressive discourse to advance the frontiers of community knowledge (Scardamalia, 2002). Students take *collective cognitive responsibility* to advance not only their own ideas, but those of others in the community for collective growth. Potential synergies are seen in TWG 2's focus on the importance of cultivating students as learning leaders, where leadership for learning is distributed among participants. Knowledge Building commonly involves internet research and online social interactions; developing supportive social-emotional contexts for knowledge work and digital citizenship is aligned with TWG5's goals of addressing the cyber-wellness of youth.
- *Technology affordances and advances:* Knowledge Forum technology evolves with Knowledge Building theory and pedagogy optimized for supporting creative knowledge work across levels; as well, Knowledge Forum technology is continually developed with input from different stakeholders. Potential synergies are seen with (1) TWG 1's centering on new technology developments, as new and innovative technological affordances and devices may have implications for supporting knowledge building/creation processes, and (2) TWG 6's focus on learning analytics connects with ongoing development of Knowledge Forum analytics to support knowledge creation (Chen & Zhang, 2016).
- *Teacher/stakeholder learning and creativity*: Knowledge Building research has documented the importance of teacher communities, and how educational stakeholders in technology-supported, site-based, regional, and/or international communities work collectively to advance knowledge creation (Tan, Chue, & Teo, 2016). Potential synergies are seen with a) TWG 3's focus on fostering creativity in teaching and developing infrastructures supporting teacher ideation, problem-solving, risk-taking and productive failures, and b) TWG 10's call for scalability and sustainability efforts to develop collaborative and participatory means of engaging various educational stakeholders.

Strategies and Actions

TWG13 advocates international tripartite school-university-government partnership – the SUNG model, grounded in coherent theory, pedagogy and technology to support open and connected Knowledge Building communities in education (Figure 3). This approach aligns with learning sciences research on design-based implementation research (Coburn & Penuel, 2016) and supported by Knowledge Building research on school networks and educational innovation (Laferrière et al., 2010). We propose the following interrelated, systemic innovation strategies for policymakers, practitioners, and researchers:

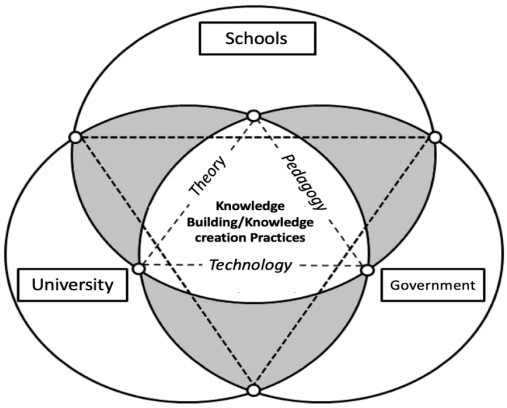

Figure 3 A tripartite model of school-university-government (SUNG)

Strategies and actions for policy makers

- adopt systemic, holistic, and ecological approaches to create diverse pathways that increase sustained classroom and school innovation in knowledge creation;
- engage in participatory politics to build relationships and co-construct policies involving different stakeholders in developing aligned policy and practice; and,
- provide accessible and functional technological environments to support classroom innovation of knowledge creation in schools; create failure-safe cultures for teachers to experiment and work as Knowledge Building communities.

Strategies and actions for practitioners

- engage in knowledge creation processes supported in Knowledge Building communities;
- use principles-based practice supported by analytics tools to enhance evidence-based teaching improvements;
- work with fellow teachers in professional learning networks and engage in continual PD and Summer/Winter Institute exchanges to advance knowledge-creation practices.

Strategies and actions for researchers

- develop a framework and repository for compiling and synthesizing evidence to impact policy and practice;
- work with practitioners to identify and create exemplars and case studies of Knowledge Building/creation practices;
- develop and provide customized communication of research findings to stakeholders (e.g., research briefs for policymakers; vignettes & visualizations for practitioners).

We advocate that strategic actions need to be taken in integrated manners -- Through multi-party and multi-level partnerships, continual improvement needs to happen at all levels of the system in building collective capacity for innovation. TWG13 stresses that teachers and students are learners and creators of new knowledge. Developing technology-supported Knowledge Building communities for emerging re-alignments would help place schools at the centre of knowledge societies and facilitate students' becoming lifelong innovators.

Actions from the TWG

TWG13 team members have been actively involved in research and working with practitioners and policy makers since 1980s. Currently, the Knowledge Building approach is implemented in classrooms, schools, tertiary institutions and school systems across the Americas, Asia, and Europe. Knowledge Building International (http://ikit.org/kbi) is a global design community with networks of researchers, teachers, school leaders, policymakers, and engineers working together and meeting regularly – in Summer Institutes, the Knowledge Society Network, and other virtual events, creating knowledge about Knowledge Building. (https://ikit.org/kbi/index.php/summer-institutes/). Further actions and proposed work among KBI members include developing Knowledge Building Collaboratory resources and artefacts; analysing longitudinal Knowledge-Forum data across different research sites; developing global webinars and PD workshops for researchers and teachers; creating new design experiments to engage students, teachers, and other stakeholders; and exploring cross-sector, cross-level systemic change in different systems. TWG13 looks forward to working with related TWGs and to developing networks of knowledge communities for advancing knowledge creation in education.

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Appendix A – EDUsummIT Committees

Steering Committee for EDUsummIT 2019

- Joke Voogt, University of Amsterdam, The Netherlands, *Founder*
- Gerald Knezek, University of North Texas, USA, *Founder*
- Petra Fisser, National Institute for Curriculum Development, The Netherlands, *past programme chair EDUsummIT 2017*
- Roumen Nikolov, University of Library Studies and information Technologies, Bulgaria, *past programme chair EDUsummIT 2017*
- Margaret Cox, King's College London, UK, *Founder, programme chair EDUsummIT 2019*
- Thérèse Laferrière, Université Laval, Canada, *programme chair EDUsummIT 2019*

Organizing Committee for EDUsummIT 2019

- Alain Breuleux, McGill University, Canada
- Fernand Gervais, Dean of Education, Université Laval, Canada
- Christine Hamel, Université Laval, Canada
- Stéphane Allaire, Université du Québec à Chicoutimi, Canada
- Jean-Gabin Ntebutse, Université de Sherbrooke, Canada
- Ann-Louise Davidson, Concordia University, Canada
- Sandrine Turcotte, Université du Québec en Outaouais, Canada
- Séverine Parent, Université du Québec à Rimouski, Canada

Advisory Committee:

- Jonghwi Park: Program specialist, ICT in Education, UNESCO Bangkok Education
- Yves Bolduc: Former Minister of Education, Quebec, Canada
- Ronald Canuel: Former school superintendent, Eastern Townships, QC, Canada, and CEO of the Canadian Education Association

Appendix B – Programme EDUsummIT 2019

INTERNATIONAL SUMMIT ON ICT IN EDUCATION

EDUSUMMIT 2019

Learners and learning contexts:
New alignments for the digital age

September 29th – October 2nd, 2019

PROGRAMME

Sunday, September 29th
Pavillon La Laurentienne (LAU), Université Laval

10:30 am. – noon	*Steering Committee meeting* Pavillon La Laurentienne, LAU-1444
2:00 pm. – 4:00 pm.	*Programme Committee meeting* Pavillon La Laurentienne, LAU-1444
2:30 pm. – 5:00 pm.	*Badge collection and material pick up* (Information desk) Pavillon La Laurentienne, Entry Hall
5:00 pm. – 5:30 pm.	*Welcome ceremony* Welcome talks (Faculté des sciences de l'éducation, Université Laval, Quebec Ministry of Education, Canadian Commission for UNESCO) Programme co-chairs Pavillon La Laurentienne, LAU-1334 (auditorium Jean-Paul-Tardif)
5:30 pm. – 7:00 pm.	*Cocktail dinatoire* Pavillon La Laurentienne, Entry Hall/Atrium

Monday, September 30th Pavillon La Laurentienne (LAU), Université Laval	
8:30 am. – 9:00 am.	*Badge collection and material pick up* (Information desk) Pavillon La Laurentienne, Entry Hall *Continental breakfast* (muffin, coffee, tea, fruits) Pavillon La Laurentienne, Atrium
9:00 am. – 9:30 am.	*Welcome & Introduction of EDUsummIT2019 Theme* Joke Voogt & Gerald Knezek (brief history and IHITE, 2nd edition) Thérèse Laferrière & Margaret Cox (programme) Alain Breuleux (Canadian context) Pavillon La Laurentienne, LAU-1334 (auditorium Jean-Paul-Tardif)
9:40 am. – 10:50 am.	*Breakout sessions in Thematic Working Groups* Participants' presentations (introductory two-slide statement, five minutes per participant, including responses) Dedicated rooms for the duration of EDUsummIT2019 (annex A)
10:50 am. – 11:10 am.	*Pause-santé*/coffee break stretches
11:10 am. – 12:20 pm.	*Breakout sessions in Thematic Working Groups* Each TWG establishes link(s) between its working document and the object of the activity of the EDUsummIT2019 community (*Seeking new alignments for learners and their learning contexts*)
12:20 pm. – 1:20 pm.	*Lunch time* Variety of vegan, meat, poultry, salads, and gluten-free boxes
1:30 pm. – 2:15 pm.	*Plenary session,* LAU-1334 Thematic Working Groups co-leaders will introduce how their groups envision their contribution (2-minute each)
2:30 pm. – 4:10 pm.	*Breakout sessions in Thematic Working Groups* Each TWG identifies issues and challenges (dilemmas, double-binds or other forms of tensions if not contradictions) to be faced for their TWG to contribute to the object of EDUsummIT2019 activity
4:15 pm. – 5:00 pm.	*Plenary session,* LAU-1334 Thematic Working Groups' representatives identify key issues and challenges to be faced for their TWG's to contribute to the object of EDUsummIT2019 activity (2-minute each)
5:05 pm. – 5:50 pm.	*Thematic Working Group leaders' meeting* Pavillon La Laurentienne, LAU-1415
5:05 pm. - 6:15 pm.	*Social Gathering – including light refreshments with cash bar* Pavillon La Laurentienne, Entry Hall/Atrium

Tuesday, October 1st
Pavillon La Laurentienne (LAU), Université Laval

7:30 am. – 9:00 am.	*Incoming and Outgoing Steering Committee meeting*, LAU-1444
8:30 am. – 9:00 am.	*Continental breakfast* (muffin, coffee, tea, fruits) Pavillon La Laurentienne, Atrium
9:00 am. – 10:30 am.	*Breakout sessions in Thematic Working Groups* Each TWG focuses on actions to overcome dilemmas, double-binds or other forms of tensions or contradictions
10:30 am. – 11:00 am.	*Pause-santé*/coffee break stretches
11:00 am. – 12:15 pm.	*Breakout sessions in Thematic Working Groups* Each TWG decides on which TWGs (up to three) to invite to their group for joint action(s) for the overcoming of some dilemmas, double-binds or other forms of tensions or contradictions
12:15 pm. – 1:15 pm.	*Lunch time* Hot buffet
1:30 p.m. – 2:30 p.m.	*Plenary session,* LAU-1334 Thematic Working Groups representatives point to actions that are likely to require other TWGs' contributions. They produce a poster to this end. They invite up to three TWGs' representative(s) for potential joint action(s)
2:30 p.m. – 3:30 p.m.	Each TWG is visited by representatives from up to three other groups (15-minute visits)
3:30 p.m. – 4:30 p.m.	Each TWG listens to the representative(s) who went to other groups, examines possible joint action(s), and identifies actions to be recommended – a list of strategies will have been provided – to policy makers, practitioners and researchers through "EDUsummIT2019: Recommended advances for IT in Education"
4:30 p.m. – 5:30 p.m.	Another round at the posters during tea, coffee and biscuits; beer or wine
4:30 p.m. – 5:30 p.m.	*Thematic Working Groups leader's meeting*, LAU-1415

For interested EDUsummIT2019 participants

5:30 p.m. – 6:00 p.m.	Departure for walks in the Old Town + dinner Approximate cost for each participant (city bus & dinner: $30 - $40 CAD)

For Steering committee members

5:30 p.m. – 6:30 p.m.	Steering committee reflections, LAU-1444
6:30 p.m. – 7:30 p.m.	Passing the baton: Outgoing and Incoming steering committee joint meeting followed by dinner in Old Town for those interested, LAU-1444

Wednesday, October 2nd
Pavillon La Laurentienne (LAU), Université Laval

8:30 am. – 9:30 am.	*Continental breakfast* (muffin, coffee, tea, fruits) Pavillon La Laurentienne, Atrium
9:30 a.m. – 11:00 a.m.	*Plenary session,* LAU-1334 EDUsummIT2019: Recommended advances for IT in Education
11:00 a.m. – 11:30 a.m.	*Closing comments, next steps,* LAU-1334 Presentation by the Incoming Steering Committee EDUsummIT2021
11:30 a.m. – 11:45 a.m.	*Lunch bag collection*

For interested EDUsummIT2019 participants
11.45 a.m. – 4.00 p.m. Sightseeing (visit to the Falls, Wendake, bus rides will be provided for free)

For the Japan Kyoto 2021 leaders and the Incoming Steering Committee
5:30 p.m. – 6:30 p.m. Debriefing of Quebec and next steps

End of EDUsummIT2019

Outputs from the EDUsummIT2019

IT Advances in Education, large dissemination
E-Book, to be edited by Petra Fisser – same approach to previous EDUsummIT ebooks
ETR&D, edited by Joke Voogt & Gerald Knezek
CJLT, edited by Margaret Cox & Thérèse Laferrière
Social media: Twitter, blogs, websites etc.

Wednesday evening, October 2nd
Pavillon De Koninck, Atrium, Université Laval

ÉVÉNEMENT FRANCOPHONE

Centre de transfert pour la réussite éducative du Québec
19h

Assemblée générale du CTREQ
20h

Courants numériques – Vents québécois : les utilisations du numérique en éducation

Thérèse Laferrière (coprésidente, Université Laval, réseau PÉRISCOPE)
Georges-Louis Baron (coprésident, Université Paris Descartes)

English-speaking EDUsummIT2019 leaders summarize its outcomes
(onsite spontaneous French translation)
Joke Voogt (University of Amsterdam)
Gerald Knezek (University of North Texas)
Margaret Cox (King's College London)

Éric Bruillard et Georges-Louis Baron (Université Paris Descartes)

Des participant-e-s québécois, présents à l'EDUsummIT2019, en résumeront les résultats.

Thursday, October 3rd
Pavillon La Laurentienne, Université Laval

Courants numériques – Vents québécois : les utilisations du numérique en éducation

Travail en groupe et plénière