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Technology-integrated pedagogical practices: a look into evidence-based teaching and coherent learning for young children

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In the last decade, in particular, understanding technology use within children's play-based experiences has been an important concern for early childhood education researchers and practitioners (Danby et al. 2018; Stephen and Edwards 2018). The World Economic Forum (2019) has highlighted the pressing issue of the twenty-first-century skills gap related to the digital revolution and ways that educators and researchers around the globe can address it through technology. The critical components of the twenty-first-century skill framework, which includes collaboration, communication, critical thinking and problem-solving, capitalise on teachers' appropriate use of technology and holds enormous promise to help foster these critical skills in young children.

Although past research (Arnott, Palaiologou, and Gray 2019; Fleer 2018, 2019; Mascheroni and Holloway 2019) describe the pros and cons related to the integration of technology in early childhood education and the subsequent influences on children's cognitive learning and affective engagement with their everyday world, early childhood settings need more guidance in relation to what high-quality pedagogies with technologies may look like. This guidance needs to align closely with the founding principles of early childhood education – linked to play and child-centredness – to ensure technologies become complementary resources, rather than competing artefacts which, some consider, may threaten early childhood ways of being.

This special issue brings together ground-breaking research on pedagogies for early childhood technology integration. Studies provide myriad evidence that practitioners and policymakers refer to and adapt to offer integrated technological learning experiences for young children. The issue also provides innovative research evidence about how this can include pedagogies and practices for babies and toddlers (0–3) as well as Science Technology Engineering and Mathematics (STEM) learning in early childhood education. It presents meaningful ways to engage the disengaged, how technology as multimodal artefacts complements the interactions that happen in an EC setting, extend education outside the classroom to enable children collecting digital data.

In essence, this special issue takes a strengths-based approach and is an amalgamation of emergent knowledge that contributes to the development and implementation of early childhood *integrated pedagogies* – the complex connection between technology, pedagogy and content for effective planning, instruction and review of young children's playful learning. While many educators in our 'round the world' studies have recognised the potential of technology in promoting, for example, children's emergent literacy and STEM skills, other studies have actually provided evidence for the transformation of teachers' pedagogical practices and the interactions that technology-based toys foster amongst children.

Promoting these exemplary ways of blending physical and virtual worlds represent a progressionist view of early childhood where technologies are viewed, not as a challenge but rather an inevitable evolution in children's learning landscapes. Thus, a nuanced stance is presented here in terms of *how* early childhood educators prudently integrate technology while making instructional decisions for young children's playful learning. We present the nine included papers under four overarching points of interest in relation to the integration of technology across early childhood education, homes and society. The issue begins with the theoretical underpinnings required to better engage

with decision making around integrated pedagogies with technologies. After the theoretical frameworks are established, it is possible to better understand what children's play experiences with technologies entail in the digital era before presenting a much-needed dialogue on pedagogies and practices. The special issue closes by looking to the expansive possibilities of technologies and considers the direction of new realities for children's play and future integrated technological pedagogies. By doing so, this issue offers a forum that acknowledges and explores the complexity and richness of current 'integrated pedagogies' approaches to the construction and transfer of knowledge in our field.

Theoretical underpinning and frameworks

Vidal-Hall's study applies Educational Design Research (EDR) methodology to show how technology-focused interventions change teachers' approach to integrating digital media into child-centred pedagogy. This study demonstrates children learn with and about technology and develop digital literacies beyond operational skills. The Interactive Whiteboard, computers and LearnPads can no longer be considered as 'outside' the children's learning environment. Teachers should make instructional decisions and while integrating technologies in a playful manner into whole-class teaching as well as support the children during free-play activities. Of particular significance, Vidal-Hall's EDR design principles produce usable knowledge in the form of a solution to a problem that can be applied in other research contexts.

Pöntinen and Räty-Záborszky's work in the Finnish settings uniquely applies Ilomäki et al.'s (2016) framework for fostering the digital competence of young students in the early years of primary school education. By adapting instruction to the students' needs, teaching and learning digital competence is seen as a continuum through which students learn systematically using versatile digital devices and software. The framework propagates the significance of teachers' attempts to foster cooperation between home and school from students' perspectives as particularly important.

Children's voice, STEM-based play and experiences

Kewalramani et al.'s paper provides a robust foundation for how IoToys, for example, robotic toys and the pedagogic interactions which occur when these toys are integrated in early childhood classrooms in Australia, England, Scotland and Norway. The authors have examined the interactions in the *ecology of the playroom*, and provide evidence as to how IoToys offers a *symbiosis* of play experiences that spurs creativity, collaboration and problem-solving. Integrating IoToys play acts as a conduit for children's STEM-focused learning and activates design play in early childhood classrooms. We now have evidence for educators to start visualising and planning to integrate IoToys, which provide an inter-dependence of play experiences whereby children and educators create a common *multimodal, multidirectional and multidimensional* platform to be creative, collaborate and problem-solve together. This then creates a culture for multiple digital experts to guide and support a child's design play.

Next, Fleer's pioneering work around *digital pop up* shows a new concept of how digital technologies act as a *digital coadjuvant* as part of teachers' everyday practices. We can now say from Fleer's study that digitally enhanced practices act together with a multiplier effect on young children's engineering-motivated actions for testing their imagined models. Using digital story creating apps, children capture both the reality of the experience (what is really visible), and the imaginary situation, supporting new design solutions. As such, we are not too far away from demonstrating how children can now act as co-animators merely by educators setting up authentic real-world tool spaces for children's playful STEM-based learning.

Pedagogy and practices

Bulca and Hürrem Özdurak present a distinctive instructional approach supported with visual materials to improve children's locomotor skill learning in Turkish pre-schools. They provide a quantitative analysis to demonstrate the effects of digital physical exercise videos for improving children's locomotor skill performance. We now have 'one of its kind' evidence that children who experience more movements with the applied video modelling techniques develop and improve their motor skills.

Given the public scrutiny about the use of technology in early childhood classrooms, Brown's American study tackles the ways that technology positively influences the literacy development of young children learning English as a new language. The paper provides thought-provoking examples to early childhood professionals to showcase the essential role of technologies as semiotic resources in terms of student agency, feedback, identity, and digital play. The types of interactions that emergent bilingual early primary students engage in using technology impact literacy learning. This pushes back against school curricula with a print-centric focus. It is safe to say that a multimodal approach to literacy learning is significant for the future of early learners.

Undheim and Jernes further contribute to the knowledge of how teachers involve groups of children in collaborative, technology-mediated story creation processes. Innovative pedagogical strategies underpinning play-based learning such as *inviting to dialogue* and *explaining the practical* can be applied while *instructing* children during the animation. While Fotakopoulou et al. discuss the beliefs and experiences of early childhood educators across three countries, England, Norway and Greece, in relation to the use of touchscreen technology with the youngest children (0–3 years old) in their settings. Their quantitative findings provide thought-provoking insights into the macrosystemic factors such as how cultural contexts, pedagogical training as well as curricula/policy influences make a difference in educators' confidence and beliefs in enacting technology use for very young children.

New realities

Hatzigianni et al. continue to solidify the evidence-based practices which show the shifting nature of early childhood digital play is now moving into the area of *new realities* as 'makers of tomorrow' with 3D printing technologies. The authors' ongoing Australian research advances knowledge on how makerspaces and design thinking skills can be integrated into early childhood and early primary education. Makerspaces, 3D printing and design thinking are now seen as promising educational digital-based innovations. Early childhood educators are already familiar with their core principles through similarities with eminent early childhood theories (the Reggio Emilia approach; Froebel's emphasis on the play; Montessorian self-directed resources, etc.). It still underpins child-centredness; child-initiated learning and child-led experience; creativity; problem-solving skills; collaboration; emphasis on the process and not on the product, all of which are in line with the early childhood philosophy. As such, their study shows the integration of new realities in the form of *maker pedagogy* is innovative.

Moving technology-integrated pedagogical practices forward

In this issue, we conclude by making a special call to policymakers and curriculum stakeholders to consider the implications posed in this Special Issue. The challenge still remains in the selection of unique digital resources that are meaningful and purposeful for children's learning in developmentally appropriate ways. In consolidating this body of research we ask:

- What are some ways in which practitioners can be supported to continue the integration of technologies within play-based pedagogies in an early childhood playroom?
- What systematic forms of inquiry can academics and practitioner-researchers do to provide opportunities for technologically assisted experiential learning for young children?
- What are some new horizons and prospects that will serve as a continuum of professional learning for practitioners to enhance the quality and impact of children's playful learning and development in the said field?

We invite researchers to use this special issue as a guide for orienting future research.

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