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**Symposium title:****Young children learning with mobile devices: Research on design and implementation**

**Session abstract:** The increasing growth and usage of mobile devices, such as tablets and iPads, by young children has not yet been accompanied by systematic research about the effects they have on children's learning and the conditions that facilitate or hinder learning and engagement. As a result, only few empirically-based guidelines exist to guide parents, educators, and application (app) designers when choosing or designing apps for young children, often leading to non-evidence-based decisions, or the design of apps with little educational value. This symposium aims to bring together researchers from Australia, the UK and USA to discuss what evidence exist about the learning potential of mobile devices and apps for young children and how it could be used to inform relevant stakeholders.

**Session summary**

**Objectives of the session:** This session aims to: (1) engage with available evidence and debate about the impact of mobile technologies on children's learning and development, (2) identify the conditions and design features that facilitate or inhibit learning and engagement with apps in diverse contexts (e.g., formal and informal learning settings), and (3) drawing from (1) and (2) provide evidence-based guidance to parents, educators, and designers on how to choose or design educational apps for young children.

**Overview of the presentation:** This session examines young children's learning from mobile devices across settings (formal, non-formal, informal) and from multiple theoretical perspectives, including human-computer interaction, technology-enhanced learning, and motivation and engagement. Papers 1, 2, 3, and 4 discuss app, learner, and context characteristics mediating learning and engagement across contexts of use. Paper 5 focuses in particular on children with Special Educational Needs (SEN) and learning benefits as perceived by teachers. Paper 6 proposes ways to help parents and professionals make informed decisions when choosing apps.

**Significance:** Mobile devices and apps are widely used by young children, yet little is known about how they affect young children's learning, or how to design apps that are appropriate for the age and developmental competences of young children (Author, 2017; Crescenzi, Jewitt, & Price, 2014; Neumann & Neumann, 2014). An evidence-based and rigorous understanding of the conditions, learner and design characteristics that facilitate or hinder young children's learning and engagement with apps is still lacking (Haßler, Major, Hennessy, 2016). This session will enhance our understanding of the evidence around learning from mobile apps, provide guidance for the design of educational apps and help parents and educators make informed decisions when choosing apps to support learning. It will contribute insights to a range of stakeholders including researchers, educators, parents and app designers.

**Structure of the session:** This is a 120-minute session with 6 presenters, including a discussant and a chair (15 minutes per presentation, including questions). Following a 5 minute introduction by the chair, each presenter will summarise their work in 10 minutes, followed by a 5 minute discussion with the discussant and other attendees. Throughout the session, the chair will take notes for discussion in the last 25 minutes of the session and for sharing with participants. These last 25 minutes will be devoted to summarizing main outcomes from the session, identifying gaps, and shaping future directions for research.

### **Paper 1: Taming technology: Evidence-based principles for app and e-book use**

**Purpose:** How can scientists help educators and parents make sound choices about children's digital media use? While the number of children who have access to smartphones and tablets is rapidly growing (Common Sense Media, 2013), more research is needed to determine how digital media affects child learning and adult-child interactions. This paper uses principles from the learning sciences to better understand (1) adults' interactions around children's digital media and (2) features of digital media that may affect children's learning from these sources. We explore how lessons learned from lab-based studies can inform classroom and home settings.

**Perspectives:** Aligning the design and use of apps and e-books with known processes of children's learning provides a framework that can be used by educators and parents alike. This framework is built upon evidence generated from the learning sciences suggesting that children learn best when they 1) actively tackle concepts, 2) engage with material, 3) learn in ways that are meaningful to their own experiences, and are 4) socially-interactive with adults or peers (Hirsh-Pasek, Zosh et al., 2015).

**Methods and Results:** Adults often turn to apps and e-books as to foster children's literacy skills. Our work has evaluated which features of traditional and e-books maximize learning. From a study with 42 parent/preschooler dyads comparing comprehension with either paper books or e-books with various features, such as narration and activities, there was no significant impact of book type. This was somewhat surprising; we hypothesized the interactive activities would invite distraction (instead of engagement) and lead to less story understanding. However, what appeared most important was reflected by a trend for children whose parent's dominant speech style created more meaningful connections between the story and the child's own life to outperform their peers on story comprehension ( $p=.07$ ) regardless of book format.

Building on this work, we have investigated preliterate children's independent e-book reading compared to parent-child reading. Many families and classrooms promote e-books' potential for independent reading, but it is unknown whether children can learn from engaging with e-books without social interaction. One-hundred-and-thirty-seven preschoolers were randomly assigned to view the same e-book via either: parent reading to child; child engaging independently with audio narration; or child engaging independently without audio narration. Overall, children who read with a parent had better story comprehension than

children who encountered the story alone ( $p = .02$ ). However, audio narration promoted comprehension over engaging independently without audio narration ( $p < .0001$ ), suggesting that e-books with this feature could be beneficial both at home and in classrooms when adults are unavailable.

**Significance:** Children are in the midst of a vast, unplanned experiment, surrounded by digital technologies. Though smartphones and tablets appeared only within the past decade, a recent survey reported that three-fourths of children under the age of 4 had their own mobile device (Kabali et al., 2015). Our research suggests that apps and e-books designed to promote active, engaged, meaningful and socially interactive learning are not just labeled “educational” but truly hold educational potential both in the classroom and at home.

## **Paper 2: Making sense of personalization in children’s literacy apps and digital books**

**Objectives:** With the advent of various forms of reading on screen, substantial empirical and theoretical efforts are being pursued to clarify the role of the specific *features* of children’s digital books. In the context of reading for pleasure, Author (2016) theorized six such features: affective, sustained, shared, interactive, personalized and creative engagement. This paper is concerned with the personalization feature and children’s reading for pleasure with digital texts (or reading on screen). The aim is to delineate key forms of personalization available in children’s digital books and to probe and suggest new directions for an emerging field of personalization in children’s reading on screen.

**Perspectives:** The main rationale for using personalization in business and marketing is to increase customers’ engagement and interest in a specific product or brand (Ardissono, Goy, Petrone & Segnan, 2002). In reading for pleasure, personalized books are claimed to support children’s self-esteem and self-concept (Demoulin, 1999) and were found to support children’s word acquisition (Author, 2014) and story comprehension in struggling readers (Bracken, 1982). However, little is known about the forms and processes through which these benefits might occur.

**Methods:** Weick (1995) established ‘sensemaking’ as a method for elucidating and recognizing theoretical patterns in new phenomena. As a focus of inquiry, sensemaking requires researchers to go beyond simple descriptions and achieve a holistic, nuanced and innovative understanding by systematically studying exemplars and their parameters. The ‘sensemaking’ process of personalization in children’s reading on screen was guided by two research questions: (1) What are the key forms of personalization in children’s e-reading?, (2) What are the relationships and interconnections among these categories?

**Data Sources:** A systematic content analysis of personalization exemplars in a hundred most popular children’s digital books was conducted. This was followed by a theoretical synthesis of the parameters and relationships among the key personalization categories.

**Results:** The five overarching categories established through the content analysis were story characteristics, narrative and appearance (products of personalization) and intertextuality and intersubjectivity (process of personalization). Theoretical synthesis of published data showed

that intertextual and intersubjective personalization can support the so-called 5As of personalization in children's reading experiences: authenticity, attachment, authorship, autonomy, and aesthetics. The extent to which these five variables are perceived as beneficial or limiting in children's reading relates to the degree of a child's agency in the personalization process.

**Significance:** The content and theoretical analyses serve as background to the definition of children's personalized reading for pleasure on screen. The different kinds of personalization identified as available in most popular personalized resources could be incorporated as additional categories for more detailed and specific scoring of children's digital books.

### **Paper 3: Seven years of research: What we've learned about young children and mobile devices at schools**

**Objectives:** This paper aims to (1) detail methods and findings from seven studies spanning 2011-2017 investigating young children and the integration of iPads into the curriculum to support numeracy, literacy, science and thinking development, and (2) debate methodological and ethical considerations related to using a device-embedded data capture system to record device and interpersonal interactions across different learning spaces and environments.

**Perspective:** The advent of relatively affordable mobile devices and apps to classrooms has presented innovative integration opportunities to support learning across different contexts evidenced in programmes such as 'Bring Your Own Device' (BYOD). While these new devices represent a major technological advancement, history suggests that technological advances by themselves are insufficient to make a significant impact on highly resistant education processes and systems (Maddux, 1986). "Hot topics" (Maddux & Cummings, 2004, p. 514) associated with the latest technological innovation spread rapidly between institutions and trigger decisions that pay little regard to any empirical research on the efficacy of the innovation for supporting claimed outcomes. The weak role research plays in institutional decision-making in this area motivated this series of studies investigating Apple's iPad, and if and how children learn when using it in the classroom.

**Methods:** This research tracked several cohorts of young children (5-11 years old) as they worked with their teachers using iPads in large, multi-teacher BYOD learning spaces. The series of 7 studies spanning 7 years used mixed-methods to learn more about how the devices and an array of apps influenced student learning in mathematics, literacy, language development, science and computational processing/coding. The studies investigated the nexus of curriculum and learning task design, assessment and technology use at different levels of the school, revealing the nature of student learning generated by different use scenarios, and how device functions and app content and design features facilitated (and sometimes hindered) achievement of learning outcomes.

**Data Sources:** An iPad embedded data system was developed that recorded the students' interactions with the apps and each other, as they completed learning tasks. Data collected

took the form of device display and audio capture that were coded using StudioCode video analysis software.

**Results:** (1) Effective device/app use is inextricably linked to curriculum and learning task design, and teachers' deep knowledge of student learning processes; (2) the learning-theoretical model upon which apps are designed, and correspondingly students' interactions within them are organised and structured, influences and at times limits their usefulness for learning purposes; (3) open apps (content creation) can be used by teachers to facilitate student collaboration when integrated with scenario or problem-based learning tasks; (4) well-designed scaffolds in apps can effectively and independently support students' procedural science knowledge.

**Significance:** Deep knowledge was gained about: the intimate relationship existing between learning task design, pedagogy and effective device use; the effectiveness of app-embedded scaffolds on enhancing students' learning performance; the effect of app design (accessibility, structure, etc.) on learning performance; and student groupings, organisation and device setup to optimise efficiency and management.

#### **Paper 4: Differences in children's affordance awareness and access between novice and experienced learners**

**Purpose:** Designers of educational applications consider many dimensions as they create their apps. Will the app be played for a few minutes or a few hours? How will the app help the player learn the educational concepts? Educators, too, must consider many dimensions when selecting apps for their students. Will the player have help nearby? Is the app for players first learning the content or for players who have already learned the content and need practice? This study addresses these latter questions for designers and educators. The purpose of the study is to examine the differences in affordance awareness and access in two groups of learners, novice and experienced, as they interacted with three virtual manipulative mathematics apps.

**Theoretical framework:** Affordances are "cues of the potential uses of an artefact by an agent in a given environment" and refer to possibilities that the agent has for action (Burlamaqui & Dong, 2014, p. 13). Moyer-Packenham and Westenskow (2016) identified motivation, simultaneous linking, focused constraint, efficient precision, and creative variation as affordance categories promoting learning. In this study, affordance awareness and access are classified according to these categories.

**Methods:** Fifty elementary school children interacted with three mathematics apps, where each app covered a different content area. Children completed four pretests, with three pretests corresponding to the apps and the fourth acting as a control. They then interacted with each app and answered interviewer questions pertaining to their awareness of affordances and connections with the mathematical content. Finally, the children completed four posttests.

**Data sources:** Data sources included pretests, which assessed initial content knowledge and allowed the researchers to classify the children as novice ( $\leq 50\%$  correct) or experienced ( $> 50\%$  correct); and interviews and video recordings, which provided information about the children's awareness and access to affordances, respectively.

**Results:** Researchers found that novice and experienced learners were aware of different affordances when playing the apps. In all three apps, novice learners attended to the motivating affordances. These children reacted positively to the literal bells and whistles included in the apps. In contrast, experienced learners did not always attend to the motivational affordances and when they did it was often in a negative fashion. Consequently, for the novice learners these motivational affordances were helpful, but for the experienced learners they were hindering. In one app, many experienced learners noticed a focused constraint affordance which gave a hint to find the correct answer. This hint was present for all children, but only a few novice learners were aware of the affordance without prompting by the interviewer. Thus, the learners in most need of the hint did not access the affordance.

**Significance:** App designers and educators must be aware of the differences in how an app is being used by novice and experienced learners. Novice learners may not attend to nuanced affordances intended to help them learn the content. Extra care should be taken in considering designing and selecting apps for these learners.

### **Paper 5: Using a reading app to teach reading to young autistic children**

**Purpose:** This case study, part of a series of studies, aims to show how teachers can be supported in developing innovative pedagogies using apps to enhance the learning of children with SEN (Special Education Needs). Teachers' feedback on the design and usability of the apps can be useful to designers to enhance specific characteristics.

**Perspective:** This study aims to inform research in using ICTs to support learning of children with SEN and to develop teachers' skills in using more effective and innovative pedagogies through the use of technology. Teachers and teaching assistants identify and develop examples of effective pedagogic practice in using apps, which facilitate reading, spelling and other basic learning blocks and aid the teaching of pupils with SEN. Additionally, it aims to develop the skills of practitioners through mentoring a colleague.

**Methods:** The research method followed a participatory case study mixed methods design where teachers and researchers exchanged knowledge and experience. In this study, evidence collected by the teacher was: video recordings of sessions, her own reflective diaries and the app's data analytics on each child's progress. The research team separately observed specific classroom sessions when the app was used, making event-based observational notes focusing both on student behaviour and progress and on the teacher's use of the technology in relation to the specified learning target.

**Data sources:** The reading app used in this case study was Reading Eggs, a well-researched app which, as well as the alphabet, includes a comprehensive phonics programme based on

instructional lessons such as core phonics and variety of vowel sounds (Beck, 2006). The participating teacher selected 5 children out of her class of eight 6-7 year olds with reading ages from 0-3 who were at different levels of development. Three of these children completed the task over 10-12 weeks with surprising literacy and autism related outcomes and the remaining two encountered barriers with sensory aspects (music and animals' special characters' clash). In all 5 cases, the teacher was able to draw conclusions both for improving the use of the app (eg., as assessment or as transition tool) and to feedback what design elements were inappropriate for her pupils.

**Results:** The data showed an increase of between one and two reading years' progress for 3 of the children in focus. Researcher's observations and the teacher's development data showed that the teacher was surprised with children's performance in front of the screen as opposed to both the paper based method and a previously tried app (Simple Reading) neither of which yielded successful outcomes for the children. She learned a lot more about the child's learning capabilities, preferences and behaviours with respect to their SEN and autism.

**Significance:** The results have implications on how to implement this type of professional development in schools at a time where resources are scarce. Recommendations to extend learning tasks and develop new ways of using the app to better assess the progress of children with SEN are also offered.

### **Paper 6: Young children's digital play: Developing online resources to support parents and professionals**

**Purpose:** Digital media and devices can provide opportunities to play, learn, communicate and be creative but we know that caregivers can get confused by mixed messages about their benefits and dangers. Families are hungry for guidance on their use of digital media. This project was funded by the Economic and Social Research Council (UK) in 2017 to engage partners, including a play charity, a state health agency and a city council, in the design and delivery of resources on digital play. The objectives were to develop research-informed content for parents of children under six and those working with families so that they could feel confident about developing their own strategies for integrating digital media into family life. This paper reports on an evaluation of a pilot of the eight-week online course.

**Perspectives:** The course was based on an acknowledgement of the role of *parental mediation* in managing family use of digital media. Originally coined to describe the management of children's television viewing (Clark 2011), the concept is now applied to digital media. The Digital Play course recognized parental concerns, but also introduced parents to the concept of *guided interaction* (Author, 2007) as a positive approach to enhancing digital play and learning.

**Methods and data sources:** All participants taking part in the pilot, except one, were female and included nurses (n=4), playworkers (n=5), childminders (n=4) and parents (n=5). Not all

disclosed ethnicity, but two identified as Pakistani, one as Chinese, and others identified as White British or White Scottish.

In week 1, participants completed a Personal Learning Plan (PLP) in which they articulated what they wished to gain from doing the course. In week 8, they were asked to reflect on their PLP in a telephone interview (n=8) and to complete an online survey to provide feedback on course design, delivery and readability (n=11).

**Results:** Based on the interviews, all or most participants considered that their views on digital play had changed, they felt more confident and informed and were able to share their knowledge with others. Finding time to do the course was challenging but the content was interesting, enjoyable and accessible.

The survey revealed that all or most participants considered the course content interesting, attractive and useful, and that the core content and the additional resources were easy to understand, and the website was mainly easy to use. Although, there were some operational problems.

**Significance:** The partnership model for developing and delivering content was successful and could be emulated for other family-based learning projects. Participants reported changes in attitudes to digital play and subsequent shifts in family practices. The purpose of the funding was to make research findings accessible to non-academics, but retaining the nuance and integrity of research while making it user friendly. This was challenging so we would provide different pathways for the next iteration when the course is deployed on a wider scale. All participants stated that the course met their expectations in relation to learning about digital play and that they would recommend the course to others.

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