



## LITERATURE REVIEW: DIGITAL DEVICES PROGRAM DESIGN, PLANNING & IMPLEMENTATION

ICT Committee, Literature review working group:

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### GENERAL PEDAGOGY RECOMMENDATIONS

- Student must have base/sound knowledge of functional navigation and use of the iPad/device (Falloon, 2013; Viriyapong & Harfield, 2013). Student capability in use of devices is considered equally important as teacher capability (Starkey, Sylvester & Johnstone, 2017), where not all students can be considered 'digital natives'.

### PEDAGOGY / RECOMMENDATIONS FOR TEACHING WITH IPADS:

- Positive learning reinforcement / scaffolding for learning activities encouraged to ensure students build knowledge and have improved outcomes (Falloon, 2013)
- Teacher vigilance on the use of the devices was advised to monitor the students so that they remained productive (Falloon, 2013)
- When devices are used in larger groups it was found that 'firm ground rules needed to be established to avoid individuals dominating "display time" (Fallon 2013 p.77)
- Digital didactical design *that focuses on fostering students' learning* requires devising teaching objectives to allow students to develop skills and competencies that match the teachers learning goals and nurture students learning progress. (Jahnke & Kumar, p.82). Unlike structural design, didactical design includes social relations and its implementation may require altering of existing teacher communications.
- Digital learning strategies do not have to be entirely device based and can draw upon extracted information from digital sources etc, about developing these skills as opposed to just a focus on Technology access (Adhikari, Mathrani, & Scogings, 2017).
- High effect sizes on learning outcomes were found for inquiry-oriented teaching methods, mixed methods and computer-assisted testing methods. Lectures and self-directed study were around medium effect sizes. However, cooperative and game-based learning did not show significant effect sizes (Sung, Chiang & Liu, 2015)
- Combining the features of individuality and instant message delivery resolves the past difficulties of putting instant formative assessment into the classroom (e.g., Chen & Chen, 2009), such that these assessments can even be performed outdoors with equal ease (e.g., Shih, Kuo, & Liu, 2012). Another feature that empowers the teaching and learning process is the portability and context awareness of mobile devices. These two features allow learners to exploit the information in the environments in which they are situated, and to retrieve, record, and react to the data needed to resolve their learning issues by traversing multiple learning environments, such as fieldwork and museums (e.g., Tan, Liu, & Chang, 2007 – in Sung, Chiang & Liu, 2015).

### Working in pair / groups with iPads (Falloon, 2013; Jahnke & Kumar, 2013):

- verbal interaction helped the children to understand and complete the task (eg debate about content such as characters, backdrops and scenes)

- Students were able to coach one another to work towards the goal of getting the task completed; partnerships facilitated pair support in spelling, punctuation, sentence structure.
- A high level of collaboration within pairs lead to learning scaffolding and development of important communication skills (such as debate, negotiation and evaluating the merit of each person's suggestion to come to an agreed outcome. Fallon 2013 p.93)
- iPads allow for of the spot demonstrations though it must be noted that the size of the group viewing can make a difference - the use of larger screen to mirror the iPads onto can help with larger groups for better viewing
- Co-constructing concept maps (Lai & Wu, 2006), peer evaluation (Lan et al., 2007; Roschelle et al., 2010), and building consensus (Zurita & Nussbaum, 2004) were activities on devices that facilitated positive interactive relationships among team members (e.g., Lan et al., 2007; Zurita & Nussbaum, 2004), however, these teaching methods did not enhance the learning outcomes compared with the cooperative scenarios without using mobile devices.

#### **Positive student outcomes re: use of general devices / iPads:**

- A meta-analysis of around 40 studies reflected strong positive effects of use of digital mobile devices on learning (where learner groups contained children of approximately the same age). Hand-held devices yielded stronger learning effect sizes than other categories such as laptops (Sung & Chiang & Liu, 2015) perhaps due to the fact that studies with handhelds tend to integrate innovative teaching methods (Lu, 2012). (It is important to note here that most of the research on handhelds in education has involved only short-term interventions,).
- Available research indicates that there is merit in the implementation of BYOD approaches and practices in primary schools (see Sweeney, 2012; Johnson et al., 2014 in McLean 2016; Shapley et al., 2010b in Newhouse, 2014).
- Reported benefits associated with mobile learning devices in schools include high levels of student engagement through interactive assignments, the use of a range of apps to teach core curriculum skills and independent inquiry learning opportunities (Bruder, 2014 in McLean 2016).
- Digital literacy, student engagement and motivation, communication collaboration and productivity has improved using when using iPads in classrooms for K-12. (Chou, Block, & Jesness, 2012; Henderson & Yeow, 2011; Hutchison, Beschoner, & Schmidt-Crawford, 2012; Pegrum, Oakley, & Faulkner, 2013 in Jahnke & Kumar 2014 p.81)
- Devices demonstrated student enhancement in critical thinking, analysis and research capabilities (Adhikari, Mathrani, & Scogings, 2017).
- iPads allow students to personalise and transform texts to better understand them (Jahnke, & Jumar, 2014)
- Oral and written literacy skills evidenced to be developed with iPad learning (Falloon, 2013)
- Increased capturing of student attention; increased appeal and excitement re: learning activities (Saine, 2012 in Falloon, 2013)
- Open-format apps are carefully selected to link with learning goal outcomes they can produce "flexible and engaging environments for students working together to exercise learned knowledge and skills" (Falloon, 2013 p.78)
- With multiple app use students seemed very capable of working the interface 'quickly and accurately' and were able to 'easily transfer skills from one to the other.' (Fallon 2013 p.94)
- The practicality of using a hand held device over a computer with a mouse is that there was not the need for as much careful attention or 'physical/eye coordination'. Fallon (2013 p.94) noted that for year 1 students that there was real advantage using hand held devices as it allowed a more 'tactile form of interaction'.
- The content creation apps backed up literacy methods learned in the class environment and offered students a 'risk-free testing ground (Falloon 2013 p. 95) to practice things such as spelling, spacing, capitalising, punctuation and sentence structure. Its important to note that this worked best with easy edit design apps.

- Student post-reflections on Evernote show that almost all students could make reflection (30.1%) or Critical reflection (57.7%) in science learning. Students reported that they preferred BYOD because they could save what they did in their own devices and access them anytime, anywhere. This indicates that students maintained a sense of ownership and control over their own learning, which was lacking in prior mobile learning studies where they needed to borrow the devices from school (Corlett et al. 2005 in Song & Wen, 2018)
- The touch- screen design and screen size of iPads and other tablet computers are well suited for special needs students with poor fine motor skills or limited vision. The tech- nology can offer students a sense of independence that they may have never experienced before. Their simplicity, abil- ity to be customized, and intuitiveness are additional advantages.
- It has also been documented that using iPads with English language learners has assisted with socialization and enhanced academic experience.

### **iPad specific functionality and features**

Murray & O'Cluse, 2011

- 9 inch screen with multi-touch display which can handle more than one touch simultaneously
- Responds to various gestures for instruction (pinch, flick and stretch)
- Accelerometer allows iPad to measure acceleration and movement and can measure distance and speed
- Can connect to wireless networks and via Blue-tooth
- Battery life is stated as approximately 10 hours
- Has built in microphone and speaker.
- Installed with email application, web browser, photo management tool, video viewer, eReader, ability to manage and listen to audio and view videos on iTunes, a maps program, notes program, a calendar, and the ability to search across applications

### **Teacher feedback / reactions to / tips for teaching with iPads:**

- Teachers like the easy and instant set up of tablet, as well as the size and weight of the devices. iPads allowed for effective sharing in pairs and small groups (Henderson & Yeow, 2012) in p78 notes that (though it was noted that this was small groups only).
- Research showed that for the iPad integration for students within classrooms that teacher use of the devices and their ability to become 'expert' with the technology was recommended. (McCombs & Liu, 2011 in Jahnke & Kumar 2014 p.81)
- Mobile devices promote communication and collaboration between students, teachers and institutions, provided that there are appropriate policies, structures and security (Jahnke & Kumar, 2014).
- Specific critical literacy / digital plagiarism education to occur for students to prevent digital plagiarism (Bonica, 2015)
- Use of digital technologies in powerful ways (Wei et al., 2011), for social inclusion (Warschauer, 2003), to engage, mobilize, and partici- pate in public life (Kassam et al., 2013), and to optimize solutions to problems through the use of the Internet (Van Deursen & Van Dijk, 2014). A role that schooling can play is to minimize this divide by teaching the knowledge and skills to all young people, thereby ensuring that those who may not gain this knowledge through their external connections, such as family and friends, have the opportunity to learn. (Starkey, Sylvester & Johnstone, 2017)
- Some research includes the successful use of an iPad to facilitate the reading improvement of a student with attention deficit hyperactivity disorder and the effective use of iPads to assist students with autism spectrum disorders in using spell-check tools (Kagohara, Sigafos, Achmadi, O'Reilly & Lancioni, 2012).

- It was found that iPads supported pre-service teachers' learning in four ways: developing understanding of content, developing understanding of pedagogy, staying connected, and staying organised. More broadly, iPads helped them develop a new sense of learning spaces and learning networks. (Pegrum, Howitt & Striepe, 2013)

### **iPad Apps that have been assessed / recommended:**

Falloon, 2013:

- iBooks promoted and supported independent reading
- For Grade 1, Popplet were good for brainstorming and generating plans (mind/concept mapping)
- Sundry Notes helped with written language
- Strip Designer helped with storytelling
- Puppet Pals HD (students create oral stories using built-in or imported characters and images)
- Use of the math apps (Splash Math; Motion Math Zoom; Long Multiplication) which employed different learning scaffolding strategies to support learning of decimals and multiplication improved student learning in mathematics and reduced the achievement gap between struggling students and typical students (Zhang et al., 2015)
- Apps of Skitch, Evernote, Edmodo, Camera, and Recording were used interactively by connecting the learning tasks seamlessly.
  - Skitch, an annotation app, was used as a tool to make quick sketches and label the structure of plants as artifacts in the course of experiment. As Skitch was linked to Evernote—a note-taking app, the artifacts could be directly uploaded to Evernote; then students could write descriptions of the artifacts and take down reflective notes. Thus, it made the artifacts' uploading process easier for primary students without having to save them in the computer first.
  - On the other hand, each note in Evernote had a web-link which could be embedded in the Edmodo platform. The advantage of Evernote app was that students could keep their own Be-portfolio there, which offered students flexibility in choosing the notes they wanted to share. Such functions greatly boosted the flexibility, mobility, and interactivity of learning at a relatively low cost (Wu and Zhang 2010) and facilitated students' personalized learning by setting their own learning goals beyond the classroom and following their own learning path (Kearney et al. 2012; Sebba et al. 2007; Song et al. 2012). The Camera and Recording features provided students opportunities to collect data catered for their own needs such as sharing the data on Edmodo or keep them as reflections on Evernote.
  - Integration of the apps on BYOD into guided inquiry-based learning could help young learners to advance their content knowledge. The affordances of the apps on BYOD and the guided inquiry-based learning model in the seamless learning environment functionally connected together to form an affordance network (Song 2013) which was employed by students to achieve their learning goals. (Song & Wen, 2018).
- Categories of use include rehearsal/performance assistance; creating music; teaching instruments; providing virtual instruments; audio-visual recording listening resources; and organizational support (e.g. portfolio show casing assessment work; tracking task progress/completion). (Riley, 2013) – Complete set of recommended Apps in Riley 2013.

- Leaf Trombone and Occarina for music; Star Walk to navigate the night sky; Shakespeare in Bits; Sundr Notes; Omnigraph Sketcher; Good Reader; G is an application that simulates gravity. Jungle Time for teaching about clocks and time. (Murray & O’Cleese, 2011)

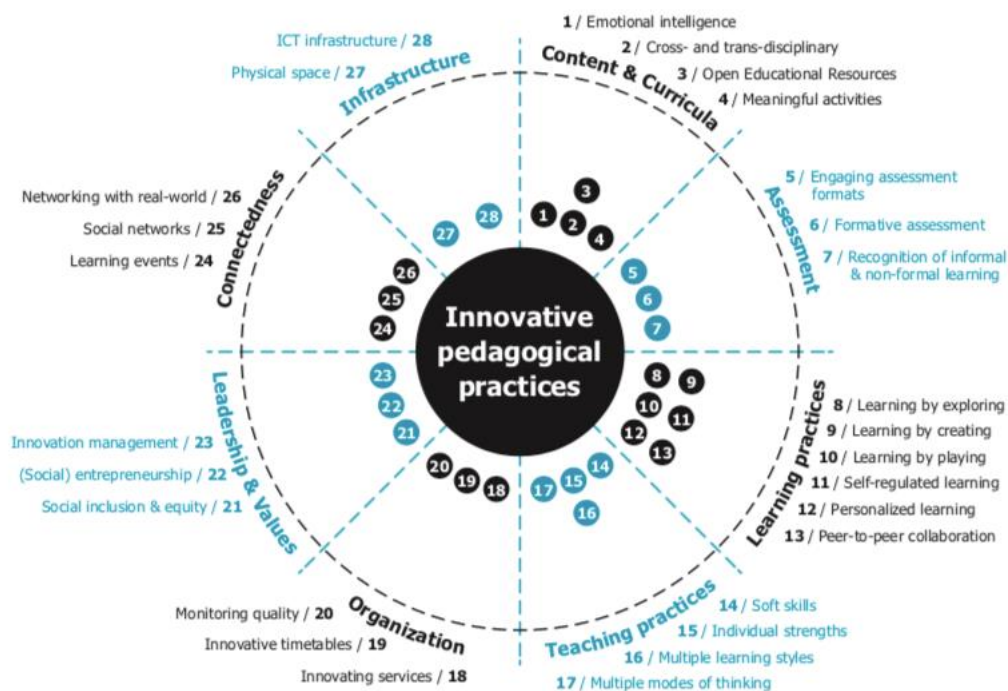
## IMPLICATIONS FOR DEVICE IMPLEMENTATION IN PRIMARY SCHOOL SETTINGS:

Recommendations on how best to support implementation of iPads (Pegrum et al., 2013)

- Provide explicit technological and, more importantly, pedagogical input for lecturers on how to use iPads, especially to encourage a higher level of student reflection.
- Ensure that lecturers provide explicit input on, and model best practice with, iPads, so that students learn how to use them in a pedagogically appropriate manner, including engaging in a higher level of reflection.
- Encourage students to use iPads to complement existing digital devices, using each for the most appropriate purposes in the most appropriate contexts.
- Encourage students to use their multiple devices, ideally including 3G/4G-enabled iPads, to learn seamlessly across formal and informal contexts, accessing the support of their personal learning networks as they do so.

Device Program design & Implementation considerations (Johnson, Adams, Becker, Estrada & Freeman, 2014)

### Elements of the Creative Classroom Framework



### Program policy development

- Drawing up an institutional policy for mobile learning will need input and agreement from the whole community – institutional head, coordinator or manager of the mobile learning program, IT staff, teachers, students and in the case of schools, parents.

- A policy that clearly articulates ownership, responsibility, safeguarding and support for a mobile learning program is necessary but can be challenging to construct (Ng & Nicholas, 2015). The policy should clearly:
  - set out the goals of the program;
  - provide a framework for the kinds of learning activities that will be needed;
  - specify ways in which teachers will be supported to develop overall pedagogy and specific activities for use in teaching;
  - reflect equity associated with ownership and use of mobile devices by including information on the provision of loan, co-contribution or lease-to-buy devices for families that cannot afford to purchase their own devices and/or software;
  - specify the device model or alternatively the minimum specification of devices if choice is to be provided to the students and their families;
  - include information on accessing the institution's wireless network, who has access to such information under which circumstances and from where;
  - state information on the type of technical support available, including provision for charging the mobile devices – do students bringing their own mobile device have to support the device and apps for learning themselves?
  - communicate the guidelines for the use of personal devices within the institution, for example outlining where and when the devices may be used, outlining responsibilities for bringing fully charged devices to classes etc.;
  - address digital citizenship such as online etiquette; copyright; guidelines that respect and protect the privacy of others by using only assigned accounts, and viewing and using data to which they are authorised;
  - provide information that ensures security for people and online safeguarding, for example in social networking and messaging; refrain from distributing private information about themselves and others
  - inform students of their rights and responsibilities, including the use of the devices appropriately, any need to abide by BYOD agreements and consequences of not doing so;
  - inform parents and students that the responsibility lies with the students to look after their own devices and that the institution is not liable for loss or damage.
- Implementation of ICT Acceptable Use policy actively encourages student use of technology in association with responsibility to protect students, staff, and the school from abuse of the system and highlights responsible use under teacher discretion. Scant abuse of trust has been noted in research involving thousands of students (Lee & Levins; Wishart, 2018)

### **Obstacles to effective implementation**

- Approaches to ensuring security and appropriate use of devices outside of school (Fogarty and Carr, 2014) include the use of guidelines to improve network management (Sweeney, 2012) and the use of filters and controls (Ullman, 2011). Additionally, A further argument against the implementation of BYOD in primary schools' centers on equitable access to mobile devices for all children (Stager, 2011; Johnson, 2012). For example, variations in models purchased, applications installed on individual devices – in McLean 2016
- Three types of obstacles to using iPads as learning tools were also identified: device limitations, time limitations, and attitudinal limitations. (Pegrum, Howitt & Striepe, 2013)

### **Funding models**

- Funding models include: Subsidized, Parent Purchased, Parent Pay (Leased) and mixed model. Benefits of parent-pay leasing include bulk purchasing power (vs parent purchased) and content/IT

management; plus cost averages and amortization of multiple years, along with packaging management and other pieces such as software costs.

- Parent Pay (Leased) reduced the need for any up front school capital expenditure (Bailey, Schneider & Vander Ark, 2012); Bulk plan has additional benefit of accidental breakage insurance cover and other advantages in bulk lease.
- Embark on ROM for a Bill of Materials across year levels in order to compare running costs on two different funding models (e.g. BYOD / classroom) - Bill

### **Measuring success**

- Embark on ROM for a Bill of Materials across year levels in order to compare running costs on two different funding models (e.g. BYOD / classroom) – Bill
- Utilisation of measures of student engagement and capability to develop content and the importance of developing sustainable mechanisms to reflect program progress and effectiveness and implementation success (Clayton et al., 2016)
- A range of precepts can guide mobile learning innovation (Viriyapong & Harfeld, 2013):
  - Capture and analyse learning in context, with consideration of learner privacy
  - Assess usability of the technology and how it affects the learning experience
  - Look beyond measurable cognitive gains and how it affects the learning experience
  - Consider organisational issues in the adoption of mobile learning practice and its integration with existing practices and understand how this integration affects attributes of in/formality
  - Span the lifecycle of the mobile learning innovation that is evaluated, from conception to full deployment and beyond

### **Information Technology**

- A few higher quality devices reflect a more successful program over numerous but poor devices (Bailey, Schneider & Vander Ark, 2012).
- Sound/proven methods for device management and content filtering recommended Adhikari, Mathrani, & Scogings, 2016).
- Consider free / low cost cloud solutions re: learning management platforms (Clayton et al., 2016)

### ***Specific platforms:***

- Learning Management Software or universal platforms may be worth considering. Refer to Clayton et al., 2016 for evaluation of Eliademy Learning Platform, where evaluation criteria may be considered/adapted for us.

### **Content/Application selection / use**

- It is important to choose the right applications for learning on the hand held devices (e.g. iPad Popplet, Sundry Notes, Strip Designer, Puppet Pals). When those are sought the evidence shows they support literacy and numeracy lessons learned within the classroom environment and are a good scaffolding that can be worked into teachers lesson plans (Falloon, 2013).
- Important to have policies, procedures and education specifically about appropriate use of devices regarding privacy considerations, as well as limit/prevent negative student behaviour including cyber-bullying (Wishart, 2018) and access to inappropriate materials (Adhikari, Mathrani, & Scogings, 2016).

### **Supporting Teachers**

- Implementation must have a teacher-centric focus, where teachers are the key to achieving BYOD program success (Adhikari, Mathrani, & Scogings, 2016).
- Teachers require skills, knowledge and experience in what more recently Mishra and Koehler (2006) have referred to as TPACK (Technological, Pedagogical and Content Knowledge). That is, the capability to plan and implement computer use to support pedagogical strategies appropriate to convey particular curriculum content. This is critical, no matter how portable the computer technology, although it could be argued that increased portability provides greater flexibility for teachers in developing this capability – Newhouse, 2014
- Actively plan and consider what interventions are required to support teachers to change how they teach with iPads (Churchill, Fox & King, 2012; Sangani, 2013))
- Management of iPads in the teaching environment was considered a challenge (due to student distraction with multiple features and functions of the iPads (Adhikari, Mathrani, & Scogings, 2017; Bonica, 2015; Chou et al., 2012; Pegrum et al., 2013 in Jahnke & Kumar 2014 p.81)
- Professional development for the use of mobile devices for teachers was considered essential (Jahnke & Kumar, 2013; Liu, Scordino, Geurtz, Navarrete, Ko & Lim, 2014).
- Teachers should be encouraged to modify already developed mobile-integrated education programs, and to gradually customize them into their own personalized program rather than simply designing their own program around the use of technology. The latter approach implicitly leads teachers to technology-adapted instruction, which means that the educational practices of the teachers may be restricted by the functions of technology, and may make it difficult for teachers to change their existing beliefs and habits. In contrast, customizing existing research-based mobile learning programs not only transfers researchers' visions and experiences for the use of technology to teachers, but also minimizes the time teachers spend on formulating new ideas and performing trial-and-error iterative procedures (Gerard et al., 2011; Penuel et al., 2007) – Sung, Chiang & Liu, 2015)

#### **Stakeholder perceptions, impacts and considerations re: acceptance/ success of BYOD**

- Overall outcomes of a digital learning program with BYOD whist initially negatively received achieved a noticeable positive outcomes over time (Adhikari, Mathrani, & Scogings, 2017).
- Engagement and consultation with parent body considered useful/essential for success (Adhikari, Mathrani, & Scogings, 2017).

#### ***Ethics, Equity and Access***

- Best to implement BYOD with a program that can ensure equivalent access to devices, especially for families who could not otherwise afford participation in the program, especially to avoid gaps developing between students with/without devices (Adhikari, Mathrani, & Scogings, 2017).
- A family engagement program to ensure families who cannot afford devices are not adversely impacted (Bonica, 2015)
- Longitudinal funding models and affordability initiatives can help improve student access to devices (Adhikari, Mathrani, & Scogings, 2016)
- Using these approaches schools purchase additional mobile technologies to supplement one-to-one ownership in efforts to ensure that all children have access to a device for learning (Ng and Nicholas, 2013; Song, 2014; Warschauer et al., 2014). There is some disagreement about whether these approaches contribute to inequities (Kobus et al., 2013) with some reports indicating that these concerns are unfounded (Nelson, 2012; Kobus et al., 2013), however tensions surrounding this debate remain. In McLean 2016.

Ethics primers for consideration of a device program might include (Beauchamp and Childress, 1983 in Wishart, 2018):



- Beneficence (doing good);
- Non-maleficence (avoiding harm);
- Autonomy (respecting choice) and
- Justice (equality of access to resource).

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