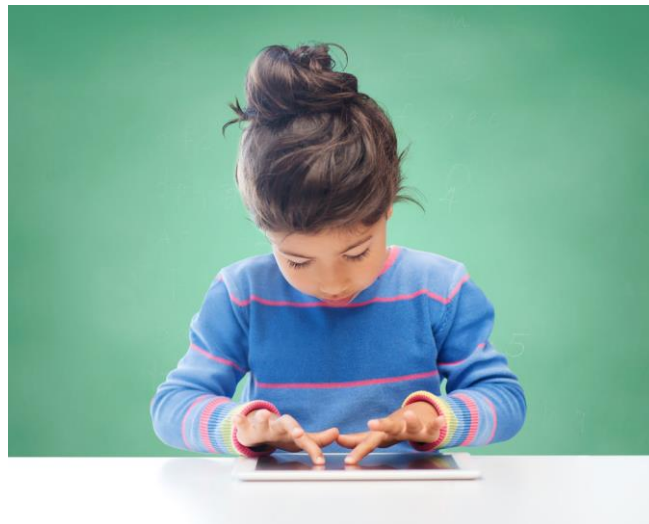


# Early Learning in STEM

## Multimodal learning in the 21<sup>st</sup> century

### PROJECT REPORT

*Research commissioned by the Australian Government Department of Education and Training under the Early Learning STEM Australia (ELSA) pilot program initiative*



CELEBRATING  
A CENTENARY OF  
OPPORTUNITY 2016

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**VICTORIA UNIVERSITY**

## Executive Summary

The purpose of this project was to investigate the range of useful STEM education Apps that are currently available for early learning in the preschool year (4-5 years of age). The approach undertaken was as follows:

1. To conduct a review of the research literature on the origins of STEM education in order to generate a **working definition** of STEM for early learning that would form the basis of the investigation.
2. To use this definition to guide a **systematic search** of the Apps available for young children in the preschool year (Aged 4-5 years of age) that could support early learning in STEM.
3. To generate a **list** of useful STEM Apps and undertake **detailed reviews** of ten Apps in order to consider their potential to engage with STEM concepts and skills and the learning outcomes as stated in the Early Years Learning Framework (quality review framework).
4. To provide a **'gap' analysis** that would enable DET to think about potential future Apps that may fill the gap and provide innovative contexts for new learning in the early years.

The findings from this project are:

1. The conceptualisation of working definition of STEM for early learning that refers to **the creation of learning environments in which children's curiosity about the world can thrive via systematic, authentic investigations that utilise a range of design thinking skills and scientific knowledge and processes** which forms a useful foundation for educators to design exemplary STEM learning activities in the preschool years
2. A table listing forty five STEM Apps that align with this definition that can be categorised as being:
  - a. *Skills based*: playing an important role in complementing real world materials and events to help young learners acquire essential foundational skills and concepts for learning.
  - b. *Exploratory games-based*: to extend the foundation skills to create new contexts for learning in a digital world.
  - c. *Construction and experimentation*: that enable young children to play and build with STEM concepts.
  - d. *Interactive eBooks*: that complement traditional storytelling events with digital books to offer possibilities for interacting with narratives in new and dynamic ways.

- e. *Creative and open-ended*: supporting the communication and documentation of ideas and new knowledge in multimodal formats.
3. Ten detailed reviews that describe the functions of the Apps and consider their potential to engage with STEM concepts and skills as well as the learning outcomes as stated in the Early Years Learning Framework (EYLF). This information enabled a quality review framework based on the academic literature (e.g. Handal et al. 2013; Lee & Cherner 2015; Hirsh-Pasek et al 2015) to be generated and presented as a *matrix* to link the selection, review and appraisal of the Apps explicitly to the five stated EYLF learning outcomes.
4. A 'gap' analysis that revealed that there are a large number of Apps available on the market, but only a limited number can be considered as being useful to educators to encourage STEM in early learning. There are opportunities to enter this App environment with innovative designs that are cognisant of the pedagogies and practices of early childhood educators to support multimodal early learning via playful explorations (Yelland, 2011). These could include narrative based experiences that incorporate the use of customised characters for learners to identify with as they embark on learning journeys that contain the elements (skills, concepts and dispositions) of STEM education. There is also an identified need to support early childhood educators with educational resources that encourage them to use existing Apps in diverse and interesting ways. These can be supplemented with professional learning opportunities in communities of practice. Such advice and support will encourage multimodal learning using both digital, traditional and real world objects.

These findings lead to six recommendations.

## Recommendations

1. A conceptualisation of STEM for early learning be adopted, that pertains to ***the creation of learning environments in which children's curiosity about the world can thrive via systematic, authentic investigations that utilise a range of design thinking skills and scientific knowledge and processes.***
2. A list of appropriate STEM Apps, based on a systematic search of available resources, and which are suitable for encouraging early learning be provided to Australian early childhood educators.
3. Educational App developers and educators can be directed to informative online reviews of products (Apps) that will inform them in more detail about what is available to support STEM education in early learning.

4. Educators are supported and encouraged to think about the ways in which the use of Apps, together with traditional learning and play activities, can link to the learning outcomes as stated in the EYLF.
5. New learning Apps that would fill an important 'gap' in the current App environment should feature:
  - a clear context and narrative
  - characters that young children can identify with
  - activities that stimulate curiosity and are challenging
  - opportunities to practice skills and communications
  - connections to the real world in terms of ideas and events
  - the ability to return to the activity at a later date
  - the building of skills and knowledge in sequence, and
  - visually attractive and engaging graphics and interactivity.
6. Educational resources can be created for educators to illustrate the ways in which existing Apps might be linked to early learning programs as well as extended with non-digital materials.

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# Introduction

## Background

This report pertains to STEM education and the early learning experiences of preschool children (aged 4-5 years of age). In particular it focuses on the use of tablet technologies (iPad) and the ways in which they might provide opportunities for young children to participate in investigations of their lifeworlds, that is, all the places that young children inhabit. This learning forms the foundation for later learning in terms of the acquisition of knowledge, skills and dispositions that will enable children to participate in schools and society in a meaningful and productive ways.

This research report was commissioned to:

- Identify a range of STEM Apps currently available on the iTunes Apple store that generate STEM learning opportunities for children aged 4-5 in early learning environments.
- Develop a working definition of STEM for the early years.
- Conduct a gap analysis of the identified early learning STEM Apps that explicitly connects these with the Early Years Learning Framework (EYLF).
- Review 10 exemplary Apps in depth and develop a qualitative review framework.

In this section a working definition of STEM for early learning is derived from the research literature and linked with early years pedagogies as exemplified in the Early Years Learning Framework (EYLF)<sup>1</sup> This conceptualisation then forms the basis of a systematic search of the Applications (Apps) currently available for STEM education that are available in iTunes.

## STEM education

Increasingly as we proceed through the 21<sup>st</sup> century concerns are expressed about the ways in which schooling systems are able to prepare students for radically different lives from previous generations. This has been manifested in the 21<sup>st</sup> century skills movement (e.g. Partnerships for the 21<sup>st</sup> century 2008, Trilling & Fadel, 2009) that focuses on the key skills of critical thinking, creativity, collaborations, and communication and now incorporates citizenship and

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<sup>1</sup> EYLF, Belonging, Being & Becoming [accessed 18/05/16],

[https://docs.education.gov.au/system/files/doc/other/belonging\\_being\\_and\\_becoming\\_the\\_early\\_years\\_learning\\_framework\\_for\\_australia.pdf](https://docs.education.gov.au/system/files/doc/other/belonging_being_and_becoming_the_early_years_learning_framework_for_australia.pdf)

character. There has been an increasing realisation that because new knowledge is not, by definition, predictable in advance, the skills required to function in the new era are grounded in being able to engage in critical thinking, problem solving, and problem posing in collaborative global contexts across traditional disciplines. Many governments and educators view this as a science based issue and are concerned about the lack of interest of students to study the traditional science subjects in schools and universities. This concern has been manifested in the STEM movement.

The National Innovation and Science Agenda (NISA) in Australia<sup>2</sup>, puts innovation and the sciences together at the core of the Government's policy agenda. Reforming the Australian curriculum forms a significant aspect of the strategy to capitalise on building our scientific capacity. Inspiring STEM literacy by 'engaging preschoolers with fun experiments, inquiry and play-based learning apps focused on STEM concepts' is an integral part of the program.

As far back as 1985, the Carnegie Foundation recognised and stated that a basic goal of their educational programs was to enable projects that would improve the chances for all (American) children to be educated so that they were able to participate effectively in a changing economy. There was a recognition that excellence in education was linked to high performing economies and that critical thinking skills were essential for participation in modern societies in the new century. A forum was established that year to consider how education could make a contribution to prospering economies had many questions including; How a national science policy might affect education and the economy and whether initiatives to improve education in science, mathematics, engineering, and other technology-related subjects were likely to meet the country's needs. At that time it seemed as if the four disciplines (science, mathematics, engineering and technology) might generate ways in which the conceptual understandings and techniques specific to their area could adapt to changing times. But gradually there came a realisation that the viability and relevance of scientific thinking in the 21<sup>st</sup> century lay in an *interdisciplinary* approach that enabled inter-relationships to flourish and ideas and innovation to connect at many levels of understanding, and the concept of STEM was initiated.

Hence, contemporary definitions of STEM – a term that seemed to have its origins in a 2006 Congressional forum - have not only highlighted the interdisciplinary functions of thinking scientifically, but also that applications of such thinking need to occur in 'real world' contexts or problems. A widely

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<sup>2</sup> NISA Agenda Report (2015),

<http://www.innovation.gov.au/system/files/case-study/National%20Innovation%20and%20Science%20Agenda%20-%20Report.pdf>



supported definition that has been generated over a period of time in the early part of this century came from Pennsylvania in the United States<sup>3</sup>:

STEM Education is an *interdisciplinary* approach to learning where rigorous academic concepts are coupled with real world lessons where students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy. (p.3)<sup>4</sup> [italics added for emphasis]

An essential criterion in the design of STEM experiences is that they must be authentic and involve 'real world' applications of knowledge and skills. This means that in schools, STEM education should integrate concepts and processes that are usually taught as separate subjects in different classes and emphasise the application of knowledge in real-life situations. A STEM 'lesson' is generally concerned with finding solutions to authentic problems via investigative approaches. At the secondary school level STEM activities might involve building models and simulating situations.

## STEM and early learning

The early years (birth to 8 years of age) are characterised by play-based pedagogies in which educators adopt guided instruction as a fundamental pedagogy to support active learning. Approaches to planning for effective learning are flexible and based on observations of individual children's learning needs. The research literature in Mathematics and Science informs early childhood educators about successful strategies to promote learning. It advises that the acquisition of conceptual understandings and strategies for problem solving and posing should be encountered via inquiries and explorations that embody a constructive approach encapsulated in the phrase 'learning by doing'. There is a long held belief that the foundational skills of mathematics and science enable young children to explore their interests when these are scaffolded by their teachers. There are currently no available definitions of STEM in early learning so it was necessary to create one in order to clarify the context, and outline the scope of this project.

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<sup>3</sup> Pennsylvania STEM Network, Southwest Region, Long Range Plan (2009-2018), Plan Summary,

<http://www.cmu.edu/gelfand/documents/stem-survey-report-cmu-iu1.pdf>

<sup>4</sup> Science is the observation, identification, description, experimental investigation, and theoretical explanation of phenomena. Technology is the application of scientific advances to benefit humankind. Engineering is the application of physical, mathematical and mechanical principles to practical purposes. Mathematics is the language of science that deals with logic, patterns, quantity, shape and change.

Based on an extensive review of contemporary research literature, we suggest that in early learning, a conceptualisation of STEM refers to ***the creation of learning environments in which children’s curiosity about the world can thrive via systematic, authentic investigations that utilise a range of design thinking skills and scientific knowledge and processes.*** Early childhood educators can support authentic investigations by scaffolding the use of strategies for problem solving and problem posing and embrace a holistic approach to scientific thinking and reasoning. Young children’s explorations and meaning making are based in their real world experiences. The acquisition of foundational skills in literacy and numeracy enable everyday investigations. Accordingly, early STEM experiences involve ensuring that young children can *acquire* and *use* these foundational skills appropriately, in meaningful contexts that are relevant to their everyday lives.

As an example of how this can be enacted for effective early learning, Yelland, Cope and Kalantzis (2010) worked with educators and teachers in the preschool early, primary and middle years of schooling in an Australian Research Council (ARC) funded project called ‘Learning by Design’. In Learning by Design, pedagogies are considered as knowledge processes; *experiencing* (known and new), *conceptualising* (naming and theory), *analysing* (functionally and critically), and *applying* (appropriately and creatively) (see Figure 1 below).

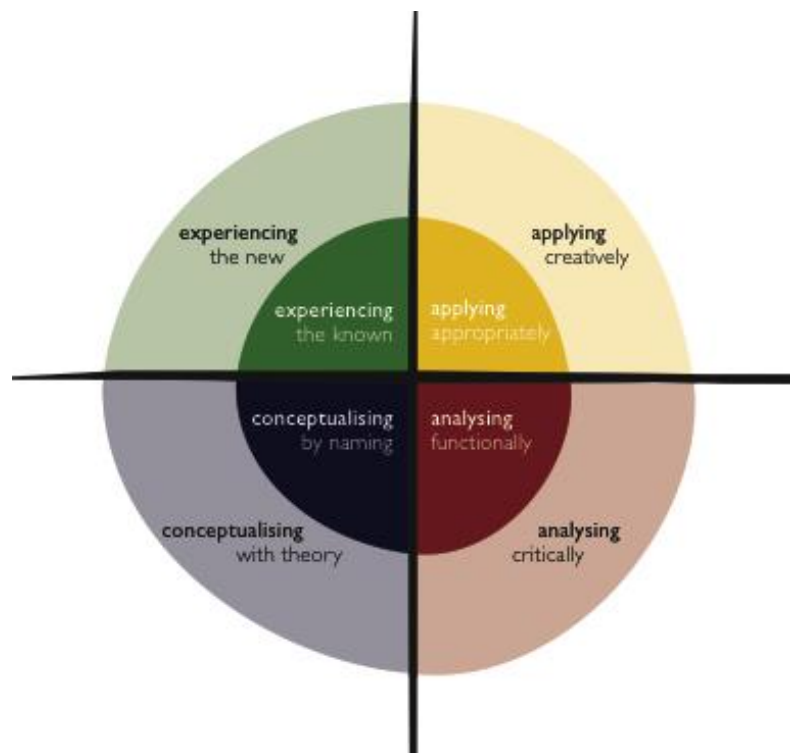


Figure 1: Learning by Design framework

This framework is particularly useful for promoting STEM activities in early learning because these knowledge processes provide prompts for teachers as

they design learning experiences that are appropriate for their students. Planning can be integrated around a theme (see Figure 2 below for an example, Living Things) and a variety of resources can be drawn upon to promote active and multimodal learning that is meaningful.

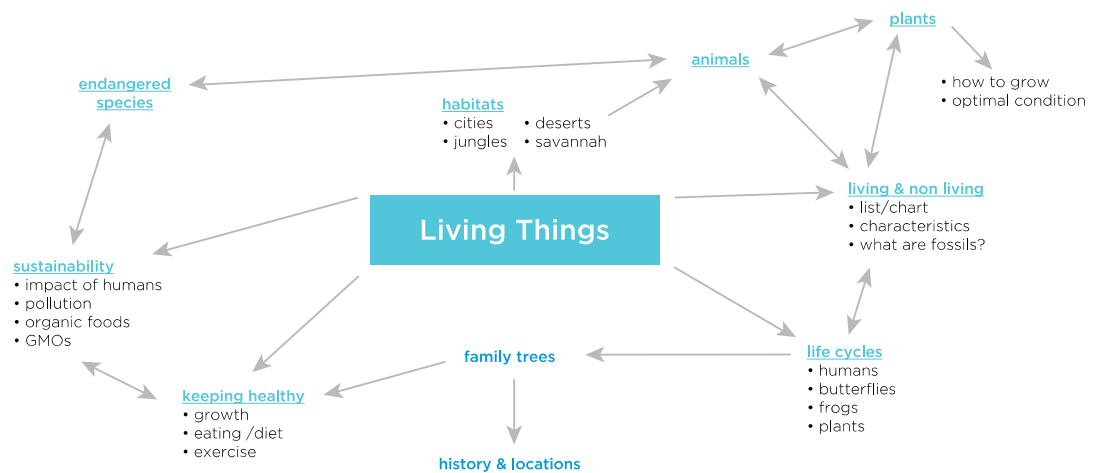


Figure 2: Living Things curriculum web (from Yelland & Gilbert, 2015)

## Multimodal Learning

It has been noted that what is different about learning experiences in the 21<sup>st</sup> century is that they are multimodal (e.g. Yelland, 2015). Rich learning experiences for young children include linguistic, visual, kinaesthetic, aural and spatial modalities and these occur in the real world and via digital experiences. Drawing on all these experiences are what makes learning deep and rich. Apps can be incorporated into learning activities and not be limited by the specific function of their design. For example, the Bugs and Numbers App essentially provides experiences with early numbers. Yet, the graphics are so attractive that they might lead to questions and investigations about the variety and type of bugs that we know about and explorations about how and where bugs like to live. Similarly, the eBook, *Teddy's Day*, is a book about a young girl wondering about what her Teddy bear does all day while she is at school. This can act as a catalyst for exploring routines at home and school, day and night, games we might play, and exploring gardens.

This approach resonates with the aim of the EYLF to extend and enrich children's learning from birth to five years and continue into the school years. The framework provides a view of children's lives as being characterised by *belonging, being and becoming*. An essential component of achieving these states is to be connected to your lifeworlds in unique and dynamic ways and to

be able to explore aspects and ideas in relevant ways. In the EYLF five learning outcomes are stipulated; they are that children will:

- have a strong sense of identity
- be connected and contribute to their world
- have a strong sense of wellbeing
- be confident and involved learners
- be effective communicators.

These outcomes form the context for the work reported here. They act as the background for considering the ways in which Apps can constitute valuable resources for early learning. The context includes a consideration of both curriculum and pedagogies that are relevant to early childhood settings. Implicit in the use of the resources considered and reviewed are that they form a part of a suite of multimodal resources that can make a contribution to early learning in the 21<sup>st</sup> century.

The role of early childhood education and early learning and its impact on subsequent learning as children progress through schooling systems has long been recognised (e.g. Perry Pre School, Schweinhart et. al, 2005). If we are able to build and support 21<sup>st</sup> century STEM education in the early years of education, we have the potential to grow a generation of new learners with new technologies (Yelland and Gilbert, 2016a) that will assist us to be an innovative nation in which citizens are capable to participate fully in productive ways.



# A systematic analysis of STEM Apps for early learning

## STEM Apps and early learning

Internationally, it is recognised that innovation and science are critical for the creation of new growth sources and economic prosperity. The focus on children's acquisition and development of science, technology, engineering, and mathematics (STEM) skills for the future workplace is beginning increasingly early. Shifts are already occurring, for example with the release of the *Australian Curriculum: Technologies*, to enhance student engagement, participation and performance in STEM. Further support for educators in the early years, particularly with new resources and professional learning opportunities, may assist to combat declines in STEM participation and support equitable access to STEM futures for all young Australians. Hence, enabling early childhood educators to find and use relevant and exemplary resources for STEM learning is critical. This includes the use of digital resources.

Data from the Apple iTunes store indicates that in excess of 100 billion applications (Apps) have been cumulatively downloaded from 2008 up to June 2015. This number is growing at an exponential rate. Educational Apps form a major category within this cumulative total. The diversity of choice has brought new challenges to educators seeking to identify Apps that effectively support the learning of young children, especially in STEM and its components. Further questions have been raised about some 'educational' Apps that appear to prioritise commercial interests at the expense of pedagogical considerations (Handal et al. 2013). To-date there have been few systematic analyses (Goodwin & Highpoint, 2012) and an absence of evaluation rubrics (Lee & Cherner, 2015) to assist educators with the identification of exemplary Apps to use with children aged 4-5 years old.

## Method

This part of the project sought to identify a range of suitable Apps to support early learning for STEM education in the preschool years (4 – 5 years of age). The following sequence of actions was taken in order to identify Apps that could support this aim:

1. As a starting point, and in order to narrow down the tens of thousands of Apps available in the Apple iTunes Education category, an analysis was conducted of the reported Top-100 paid and Top-100 free Apps. This approach is derived from the methodology outlined by Shuler (2012). A snapshot of the Lists of the Top-100 Apps was derived on the 2<sup>nd</sup> May 2016. The lists were then systematically

analysed individually to exclude the Apps within the Education category that were non-STEM and not targeted to 4-5 year olds. This was achieved by reading the brief descriptions for each App, as available on the AppAnnie website<sup>5</sup>. Where limited information was available, for example, if there was limited clarity on the age range in the description, further detail was sought from descriptions available on the iTunes store and in Common Sense Media<sup>6</sup> reviews. Apps were then categorised for inclusion or exclusion based on the following criteria of:

- *Age* – if the App either specifically noted it was aimed at preschoolers/kindergarteners or specified an age range that included 4 and/or 5 year olds, it was included. Examples include under 5s, 2-4, 4+, 4-8. A selection of Apps, listed as being appropriate for a slightly older age group (e.g. 6-8), that had the potential to generate STEM learning opportunities were also included. For example, Stellarium, Simple Machines and The Tiny Arcade. These Apps provided multisensory conceptual experiences for children and with scaffolding by educators, had the possibility to be dynamic resources to instigate investigations and building concepts and inquiry skills. Apps that did not specify age (most are listed as 4+) yet were described as appropriate for school children, for example, Grade 3 students, classrooms, or similar were excluded.
- *STEM* – where there was no clear link to STEM, the App was excluded. For example: teaching support Apps for adults; Apps aimed at helping children learn how to read, write, or speak other languages; Apps for social skills development; and colouring book Apps. Some Apps were also excluded where there was only a minor STEM component. In these Apps the central educational focus of the App was, for example, literacy (e.g. ABC Magnetic Alphabet – Learn to Write) or entertainment (e.g. Paw Patrol Rescue Pack). While we recognised that being literate enables STEM literacy, we did not specifically include phonics and reading programs which focused on the acquisition of these skills devoid of context. Apps that included mathematical concepts to support numeracy and the application of mathematics in ‘real world’ contexts were included because STEM investigations cannot occur without such foundational knowledge.
- *App ‘bundles’ and selections from a series* – to reduce repetition, for some Apps that formed part of a series, only a few items were included rather than the entire list – for example, the Toca series of Apps includes a long list including Toca Life, Town, City, Doctor, Builder, Kitchen, Kitchen 2, House, School, Nature, Monster Kitchen. Another example is the interactive eBook series by Peekaboo which has a large range of titles so only two were included here.

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<sup>5</sup> App Annie, <https://www.appannie.com/en/>

<sup>6</sup> Common Sense Media, <https://www.commonsensemedia.org/>

- *Lite versions* – these were excluded if full functionality was not available or already listed in the Top 100 Paid Apps.

This approach generated 20 Apps from the Top-100 Paid list and 12 from the Top-100 Free list for a total of 32 Apps.

2. Next, in seeking to locate further Apps for inclusion to expand the total to a realistic and usable target of approximately 50 Apps, a second strategy was pursued. In the iTunes App store, the following key words were entered. The number of returned search results is also shown:

- STEM and early childhood education (no items)
- Early childhood education (no items)
- Early childhood (no items)
- Preschool (222 items)
- STEM apps (62 items)

Searching the App store proved to be an unproductive strategy, since only 6 out of the 222 Apps identified in the 'preschool' search (2.7%) and 2 out of the 62 (3.2%) of those in STEM were relevant for this project. This highlights one of the findings from this project (Finding 4) that identified a need to support early childhood educators with educational resources that encourage them to use existing Apps in diverse and interesting ways. These can be supplemented with professional learning opportunities in communities of practice. All such advice and support will encourage multimodal learning using both digital, traditional and real world objects.



3. In order to obtain more information we returned to the research literature. Yelland and Gilbert (2013, 2014, 2015, 2016b) had found useful examples of Apps for early childhood literacy and numeracy based on using the Google search engine, as well as recommendations from experienced early childhood educators both in research and professional sites across Australia and online via Pinterest. Pinterest creates communities who share resources. Categories are created, and one productive area is a community of teachers promoting STEM teaching and learning. They were mainly primary and secondary teachers, but examples relevant to early learning were also available. For the ELSA STEM Apps project, a Google search was conducted to update the initial lists generated by Yelland and Gilbert's work, to incorporate a STEM in early childhood focus. Keywords were 'early years apps for young children'. The search recovered a large number of 'best 10' or 'best 100' Apps across the early childhood years and were highly skills-based in their focus in terms of the acquisition of early numeracy.

4. Given the working definition of STEM conceptualised in the previous section, the identified Apps were grouped thematically into five broad criteria:

- a. *Skills-based Apps* - the acquisition of early mathematics *skills* to support investigations. These included Apps like Bugs and Numbers, Tallytots Number, 123 Kids Maths, Presto Bingo Numbers, Presto Bingo Shapes, Sorting for Early Science.
- b. *Exploratory Games-based Apps* - to support learning about natural events in our world. Examples include Nighty Night (farm and circus), which allows children to explore how the farm functions, animals who are found there, day and night, dark and light, and light sources. Ansel and Clair's Adventures in Africa supports exploration about animals and plants in a variety of locations, as well as historical and geographical features of the regions.
- c. *Construction and Experimentation* through playing, building and problem solving puzzles. In building, this occurs by creating, for example, robots (Sago Mini Robot Party), worlds (Toca House), cars and monster trucks (Blaze and the Monster Machines). In problem solving (e.g. Thinkrolls 1 and 2) the game-like environments were generally exploratory settings that required the user to overcome challenges to reach a goal.
- d. *Interactive eBooks* that could act as a catalyst for investigating and thinking about aspects of our world. For example Peppa Pig at the Fair includes design and building, money, and spatial understandings. Peekaboo Forest allows children to learn about animals and understand forests as living things)
- e. *Creative and Open-ended Apps* for collating and communicating ideas. Examples include Book Creator, Jigsaw Puzzle Maker (pro), MadPad, Play School Art Maker, and Sock Puppets, among others.



The 45 Apps listed in Appendix 1 are ones that were generated based on these criteria being applied. The list contains Apps that we could recommend to early childhood educators based on our working definition of STEM, our previous extensive work in the area of young children learning with Apps (Yelland and Gilbert, 2013, 2014, 2015, 2016b), and our systematic searching of the App store, Google and Pinterest. They are presented in alphabetical order.

The next stage was to select ten Apps for detailed review. The ten were selected to illustrate the range of Apps that were available across the categories that were derived from the systematic process. Two were skills based, two exploratory games, one eBook, one construction/ experimentation and four were creative / open ended. Access to good reviews is important for early childhood educators and parents. They want to know what to use and, in many instances, how to use it. They often don't have the time or the inclination to test Apps themselves, relying instead on advice from others who have had positive experiences with the App. In particular the reviews by *Commonsense.org* media and *Curiouslittleapps.com* are a source of good information to educators and parents alike. The reviews (Appendix 3) combine elements of these and in addition specifically comment on STEM concepts and skills as well as the EYLF outcomes in order to connect with the purpose of the project.

## Linking Apps to the EYLF

All of the 45 Apps are considered in terms of their potential to achieve the five outcomes of the EYLF. This information is presented in the Mapping matrix (Appendix 3). The matrix acts as a qualitative review framework and reveals that with effective scaffolding by educators, it is possible to use all of the Apps to support early learning as exemplified by the stated EYLF learning outcomes. It requires that educators think about how they want to use the Apps to complement the curriculum and pedagogies that form the basis of the early learning program in preschool settings. The links can be made in flexible ways and are not restricted to the various types of categories outlined above. It becomes apparent that the ideas and skills inherent to each App can be extended in multiple ways 'off-screen' and that this is indeed desirable as it broadens the scope and design of each App.

Given the broad categories defined here it is evident that *Skills-based* Apps have less potential in 'on-screen' time to achieve all of the stated EYLF outcomes than the *Creative and Open-ended* Apps. However, these Apps should not be dismissed, since they provide a valuable context, or opportunity, to encounter the types of experiences that are manifested in each outcome. For example, without the foundational skills inherent to mathematics (e.g. patterning, number skills, spatial understandings) young children will not be able to embark on meaningful investigations which require higher order cognitive skills and more complex understandings of phenomena.

As an example of a skills based App that goes beyond its designed function of mastery of number concepts, the matrix presented in Appendix 3 shows that Bugs and Buttons has the potential to:

- Build self confidence, practices routines and set challenges for players (Outcome 1 – Identity)
- Build understandings (about counting and numbers) which enables young learners to be connected and contribute to their world (Outcome 2)
- Stimulate curiosity (about numbers and bugs) that might lead to further inquiry that will encourage well being of early learners (Outcome 3)
- Contribute to the child becoming a confident learner (Outcome 4) via playful explorations, building foundational knowledge, discovering new ideas and experiencing shared meanings (about number systems)
- Support extended conversations and communications (Outcome 5) via new vocabulary/ language, interpreting new ideas, and linking to real world experiences to create multimodal learning scenarios.

The detailed review of Bugs and Buttons can also be viewed in tandem with the matrix. The STEM concepts and EYLF outcomes are listed. For example, the App can be used in connection with the a study of “living things” (see Figure 2) and can engage early learners with opportunities to observe and build patterns, consider cause and effect and investigate the movement of bugs. Acquiring such knowledge and skills then make a contribution to the EYLF outcomes in the specific ways listed.

A similar mapping of ways to achieve the EYLF outcomes can be completed for other *Skills-based Apps* (see Appendix 2) as well as those that are in the other categories (*Exploratory Games-based, Construction and Experimentation, Interactive eBooks, and the Creative and Open-ended Apps*). The *Creative and Open-ended Apps* have the potential to fulfil all the outcomes in a variety of ways in the hands of experienced educators who include them in their suite of learning resources.

An important factor for multimodal learning in the 21<sup>st</sup> century is that the majority of useful Apps can be used individually, in pairs or small groups and with adults; and further, they can act as a catalyst for off screen conversations and investigations. This should be made explicit to early childhood educators as they build their repertoire of pedagogical strategies.

Finally, learning stories can be derived using Apps (Appendix 4). In this example (Yelland & Gilbert, 2014), Jenna (a kindergarten preservice teacher) illustrates the ways she uses sounds and pictures to create contexts for exploring the nature of sounds, and how we can make so many different sounds, with things in our environment. The experiences could be extended in a variety of ways to include children providing statements about themselves and what they enjoy, by telling stories, and for musical experiences with instruments and songs.

Combining the modalities of oral, aural and visual images, represents a good opportunity for a range of different learning activities that enable children to reflect on the sounds in our environment, and the sounds that we listen to in a variety of formats.

## Gap analysis

The gap analysis offers a means of reflecting on how early learning might be enriched and extended through experiences with Apps that are not yet available as well as being complemented by 'real' world experiences.

The systematic review of available STEM education Apps resulted in 45 Apps being included for the purposes of this project (Appendix 1) that were regarded as being useful for early childhood educators. As previously stated the Apps can be broadly considered in five categories:

- *Skills-based*
- *Exploratory Games-based*
- *Construction and Experimentation*
- *Interactive eBooks*
- *Creative and Open-ended Apps*

These are not meant to be hierarchical categories, but rather represent the specific design and content of the range of Apps available. Neither are they mutually exclusive. Each App might have aspects of another category, but can be categorised or allocated to just one for the purpose of considering the various types of Apps that might support and extend early learning in preschool settings.

From the huge number of Apps that are available, we nominated 45 that can be regarded as having the potential to promote STEM early learning if integrated effectively into good early childhood programs for preschool aged children (4-5 years of age). All 45 can be associated with the outcomes as stated in the EYLF, Being, Belonging and Becoming (Appendix 3) in particular ways.

Previous work with young children and tablets (e.g. Lynch & Redpath, 2014; Yelland & Gilbert, 2014) has indicated that young children are engaged in important early learning when playing with the Apps. They will play for extended periods of time individually, in pairs or small groups and with adult support. Young children can benefit from playing with skills and games based Apps (e.g. Tallytots, Nighty Night) that don't require ongoing adult support as well as being scaffolded by adults to begin their explorations with eBooks (e.g. Teddy's Day) and more creative/open-ended Apps (e.g. Book Creator and MadPad). When thinking about STEM education it is relevant to note that children need the foundational skills of literacy and numeracy in order to talk about and document their early investigations. Using tablet technologies can support such skill acquisition in useful ways.



## Future Apps

Features of the most popular software/ games (e.g. Murray, Moros & Rubin, 1999) have been understood for some time to be:

- An overarching narrative in which the game is set. For example, the game The Logical Journey of the Zoombinis is a quest in which the tiny creatures set out to solve puzzles overcome the trolls and regain their homeland.
- That they had characters/ avatars that the children can design or create themselves, with whom they could identify.
- Activities that are challenging but not too difficult. Additionally, children benefit from practice and, if repeated, the games have both random and routine events that can be re-enacted.
- High quality graphics that are attractive and appealing.
- Able to be played both individually and in pairs or small groups.
- Connected with the children's own lives (e.g. their love of cooking or eating ice cream to the appeal of going on an adventure) even with the addition of some fantasy elements.

A futures scenario for new and successful early learning STEM Apps, will take these features forward. They should incorporate a narrative with specifically designed characters and have optional attributes that could be selected by players, and send them on a journey or quest. The 'puzzles' along the way should be related to a skill (e.g. recognition and use of numbers) or more playful

explorations with the incorporation of spatial puzzles or logic blocks. There might be 'clues' to support and scaffold the learning. Occasional adult interaction with the children can be encouraged so that young children have an opportunity to extend their language skills, as well as explain and share their strategies. The overall narrative might be like those found in some of the reviewed eBooks, and the activities similar to those in the skills, games and creative categories of Apps listed here in this report. The overarching theme would have to be engaging – and since young children are naturally curious about a myriad of topics from dinosaurs to farms and from numbers to how insects move – this would not be difficult. Another important consideration is that in playing the game the young child achieves success within a time period of approximately 20 minutes and they should be able to resume their position in the game/activity when they return to it.

Some existing STEM educational environments for primary aged students (e.g. Little Bits) incorporate an 'invention cycle' that include the components of – play, remix, share and create. These could be built into a new App together with a consideration of opportunities to build capacity in the 21<sup>st</sup> century skills of critical thinking, creativity, collaborations, and communication with occasions to participate in the character and citizenship elements.

At the current time, we have identified 45 Apps that have, to varying degrees, aspects of these conditions. Additionally, there are Apps for older children that encourage exploration and documentation about findings that could be modified for use by younger children. These would have the potential to encourage STEM explorations. For example, young children could use an iPhone/ iPad microscope<sup>7</sup> or magnifying glass<sup>8</sup> to take a closer look at bugs and be able to take a photo, and record their thoughts and findings if they were immersed in a game. Children should be able to stop, take a look and record what they observe and discover.

What the 45 Apps show is that there is a fair representation of the range of types of Apps outlined here. They are not generally accompanied by documentation that informs educators of the possible valuable uses of them that would constitute effective early learning. Sometimes, as in Sock Puppets, the App contains an option to view a short video that explains the scope of the App. This can then be used to generate ideas about how to use it and is more helpful than long explanations that might be difficult to read. Thus, in addition to commissioning a new type of App for STEM early learning - it would also be relevant to consider creating educator tailored resources to accompany existing Apps to give teachers

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7 Digital microscope, [http://www.miniinthebox.com/6ox-microscope-lens-with-black-pc-back-case-for-iphone-6\\_p2302982.html?currency=AUD&litb\\_from=paid\\_adwords\\_shopping&utm\\_source=google\\_shopping&utm\\_medium=cpc&adword\\_mt=&adword\\_ct=72953447442&adword\\_kw=&adword\\_pos=104&adword\\_pl=&adword\\_net=g&adword\\_tar=&adw\\_src\\_id=4196617767\\_311897322\\_22417194042\\_pla-70787171675&gclid=CK2dpomk9MwCFYSjvQodSfkDJg](http://www.miniinthebox.com/6ox-microscope-lens-with-black-pc-back-case-for-iphone-6_p2302982.html?currency=AUD&litb_from=paid_adwords_shopping&utm_source=google_shopping&utm_medium=cpc&adword_mt=&adword_ct=72953447442&adword_kw=&adword_pos=104&adword_pl=&adword_net=g&adword_tar=&adw_src_id=4196617767_311897322_22417194042_pla-70787171675&gclid=CK2dpomk9MwCFYSjvQodSfkDJg)

8 Magnifying glass, <https://itunes.apple.com/au/app/magnifying-glass-light-digital/id406048120?mt=8>

initial and innovative ideas for using them. Educators can then build on these ideas in unique ways relevant to their own teaching contexts. We can learn from previous initiatives that did not succeed in supporting new types of learning. For example, the Learning Objects<sup>9</sup> sponsored by the Learning Federation in the early part of this century were electronic resources were made available to teachers in large numbers. However, they were not widely used because teachers did not have the time or requisite technology skills to consider how they might be used most effectively in their program. Supporting teachers with resources and professional learning so that they could create their own learning resources to enhance the use of available Apps, would be invaluable support for educators. Resources generated by supported communities of teachers could be shared online across clusters of early learning settings.

## Conclusions

In summary, this research has revealed that a conceptualisation of STEM for early learning should relate to creating contexts for young children to be curious about their world and explore it via a range of design and thinking skills together, with the use of scientific knowledge and processes. Working with this definition it is possible to find STEM Apps for early learning that will enable young children to acquire the foundational skills to embark on investigations that are relevant and meaningful to their lives. However, not all Apps enable this process. It would be useful to direct educators and App developers to informative online reviews of Apps that will advise them in more detail about what is available to support STEM education for early learning. Educators can be supported and encouraged to think about the ways in which the use of Apps, together with traditional learning and play activities, can link to the learning outcomes at stated in the EYLF.

New learning Apps that would fill an important 'gap' in the current App environment should feature:

- a clear context and narrative
- characters that young children can identify with
- activities that stimulate curiosity and are challenging
- opportunities to practice skills and communications
- connections to the real world in terms of ideas and events
- the ability to return to the activity at a later date
- the building of skills and knowledge in sequence, and
- visually attractive and engaging graphics and interactivity.

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<sup>9</sup> Victoria University Learning Objects projects, <http://vulo.cgpublisher.com/product/pub.152/prod.4>

Educational resources can be created for educators to illustrate the ways in which existing Apps might be linked to early learning programs as well as extended with non-digital materials.



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# Appendices

## Appendix 1: 45 iPad STEM Apps for Early Learning

| APP # | APP NAME                                | AGE     | THEME                            | BRIEF DESCRIPTION  |
|-------|---|---------|----------------------------------|--|
| 1     | 123 Kids MA by Mintomeg                 | 4+      | Skills-based                     | Counting skills and number recognition   |
| 2     | Ansell and Clair's Adventures in Africa | 5+      | Exploratory games-based          | Explore 3 regions of Africa with Ansel and Claire, questioning, geography, history, animal investigations  |
| 3     | Blaze and the Monster Machines          | 4+      | Construction and Experimentation | Race and build tracks adding 15 STEM items (puddles, ice, bubble gum to explore adhesion and surfaces and hubcaps etc that change cars acceleration) |
| 4     | Book Creator for iPad                   | 4+      | Creative and open-ended          | Create and publish ebooks, pdfs and comics   |
| 5     | Bugs and Numbers                        | 4+      | Skills-based                     | Series with bugs and buttons, numbers, bubbles   |
| 6     | Bugs and Buttons                        | 4+      | Skills-based                     | Series with bugs and buttons, numbers, bubbles - count, sort, solve puzzles, letters   |
| 7     | Playtime With Dora the Explorer         | 4+      | Skills-based                     | Memory games, shape matching and puzzles, explorer   |
| 8     | eBook – Peekaboo Forest                 | 5 under | Interactive eBook                | Animals and the living forest, include as example of ebook series  |
| 9     | eBook – Steam Train                     | 4-8     | Interactive eBook                | Animals and trains, record own voice   |
| 10    | eBook – Teddy's day                     | 3+      | Interactive eBook                | A little girl questions what her Teddy Bear does all day when she isn't there  |
| 11    | Eggy Time                               | 4-8     | Skills-based                     | Skills and concepts to do with telling time  |
| 12    | Explore Daniel Tiger's Neighborhood     | 2-5     | Exploratory games-based          | Explore grocery store, bakery, doctor, music shop, park to extend tv show's social-emotional curriculum  |
| 13    | Friendly Shapes                         | 4+      | Skills-based                     | Counting 1 to 10 as one of many other games  |
| 14    | Imotion/ imovie                         | 4+      | Creative and open-ended          | Time lapse and stop motion, teacher led  |
| 15    | Kids Farm Animal jigsaw Puzzles         | 6 under | Skills-based                     | Animals, Puzzles help improve children's visual memory, shape and color recognition, motor skills and coordination                                   |
| 16    | Lumikids Backyard                       | 4+      | Exploratory games-based          | Part of series, explore as night turns to day, including quantities, spatial relationships, problem solving  |
| 17    | Lumikids Park                           | 4+      | Exploratory games-based          | Part of series, explore interactive park, includes sorting based on colour, size, shape  |
| 18    | MadPad                                  | 4+      | Creative and open-ended          | Create video soundboards from everyday life (take photos and audio recordings, mix with others)  |
| 19    | More Fun With Directions HD             | 4+      | Skills-based                     | A focus on 12 concepts: turn on/turn off; up/down, front/behind, on/under, put in/take out, above/below.   |
| 20    | Nighty Night Farm                       | 1-4     | Exploratory games-based          | Blend of storytelling, animation and interactivity. Children turn off lights for 13 animals  |
| 21    | Phone for Kids                          | 4+      | Skills-based                     | Colors, Numbers, Letters, Shapes, Directions, Days of the Week, Animals, Drawing and much more.  |
| 22    | Play School Art Maker                   | 2-6     | Creative and open-ended          | Create pictures, animated movies and story slideshows using their favourite Play School toys and craft items   |
| 23    | Play School Play Time                   | 2-6     | Exploratory games-based          | Activity based children's app, activities are based on the theme of "Humpty's Day", clocks and the passage of time.                                  |
| 24    | Presto Bingo Shapes                     | 4+      | Skills-based                     | Counting and simple explanations of geometric shapes   |

| APP # | APP NAME                                 | AGE         | THEME                                  | BRIEF DESCRIPTION  |
|-------|--|-------------|--|--|
| 25    | Sago Mini Pet Café                       | 4+          | Exploratory games-based                | Help feed pets while learning about shapes, numbers, colours, for toddlers and preschoolers                              |
| 26    | Sago Mini Robot Party                    | 5+          | Construction and Experimentation       | Creative experimentation with building robots  |
| 27    | Shiny Party - Shapes & Colors            | 2-4         | Skills-based                           | Sorting, properties, names of shapes   |
| 28    | Simple Machines by Tinybop               | 2-5         | Construction and Experimentation       | Physics, explore forces, levers, pulley, etc   |
| 29    | Sock Puppets                             | 2-5         | Creative and open-ended                | Create lip-synched conversations with puppets  |
| 30    | Sorting for Early Science                | 6-8         | Skills-based                           | Children classify items into whether they are plant/animal, living/not living, # of legs, etc                            |
| 31    | Stellarium Mobile Sky Map                | 4+          | Creative and open-ended                | Star gazing tool, introduction to astronomy, quite a few examples of these - others excluded to avoid repetition of type |
| 32    | TallyTots Counting                       | 4+          | Skills-based                           | Counting up to 100, mini games that teach sorting, quantity, order   |
| 33    | Tap Number by Mintmomeg                  | 4+          | Skills-based                           | Learn to count to 10 in different ways, bigger or smaller, match number to work, how many                                |
| 34    | Tap Transport by Mintmomeg               | 5 and under | Skills-based                           | Learn about different types of transportation, with spelling   |
| 35    | The Earth (Tinybop)                      | 2-5         | Exploratory games-based                | Dig into the planet and the forces that make it  |
| 36    | The Infinite Arcade by Tinybop           | 2-5         | Construction and Experimentation       | Build games  |
| 37    | The Wheels On The Bus                    | 4+          | Skills-based                           | Includes 5 mini math games as part of whole App  |
| 38    | Thinkrolls 1 and 2                       | 3-8         | Construction and Experimentation       | Physics puzzler, navigate think rolls through series of mazes and obstacles  |
| 39    | Tiggly Chef: Preschool Math Cooking Game | 4+          | Skills-based / Exploratory games-based | Early maths skills through cooking and using ingredients   |
| 40    | TinyHands What's My Pair 2               | 3-8         | Skills-based                           | Sorting, size, number, matching, etc   |
| 41    | Toca Blocks                              | 3+          | Construction and Experimentation       | Construction, building with blocks   |
| 42    | Toca Lab                                 | 5 under     | Exploratory games-based                | Include as part of series with explicit STEM focus   |
| 43    | Toca Town                                | 4+          | Exploratory games-based                | Buy groceries, cook lunch in a restaurant, picnic in the park, play with friends   |
| 44    | Toddler Playtime Pack                    | 4+          | Skills-based                           | Number literacy, shape recognition, spatial reasoning  |
| 45    | Video touch (movies of animals)          | 4+          | Skills-based                           | Children watch series of short videos of different animals   |

## Appendix 2: 10 In-depth Reviews

1. Ansel and Clair's Adventures in Africa
2. Book Creator
3. Bugs and Buttons
4. MadPad
5. Play School Art Maker
6. Sago Mini Robot Party
7. Sock Puppets
8. Tally Tots Counting
9. Teddy's Day
10. Thinkrolls 1

## STEM App Review 1



### *Ansel and Clair's Adventures in Africa*

**Summary:**

An educational adventure game that teaches children about three geographic regions of Africa: the Nile, the Sahara Desert, and the Serengeti. Children are able to explore the different ecosystems of each area in any sequence that they choose. Each area has a number of animals to learn about, as well as other associated environmental features and cultural aspects. There are also games to play and missing spaceship parts to find and reassemble.

**Age:** 5 years

**Price:** \$4.99

**Source:** Fingerprint

**About the App:**

The narrative that accompanies the game centres on two characters. Ansel is a travel photographer from the planet Vertusia and Clair is a vertoid (a vertusian robot). They are visiting Earth to learn about Africa so they can teach their fellow Vertusians when they return to their planet. Ansel is a very curious being and while he sometimes gets into difficulty his curiosity leads him to pose many questions about the animals and other features. Clair's role is to provide the answers. Each feature in the various locations is marked with an arrow that can be 'clicked' if you want to engage with them. Once you have discovered things about the animals and places their arrow markers change to green checkmarks.

Ansel also invites players to 'drag' the camera over items to take a picture and collect the items in a travel log. Later these photos can be sorted and arranged as a journal. Additional information for some items is possible by tap a light bulb next to them. As each area is explored, the players help Ansel and Clair gather lost spaceship parts that were scattered over the land on arrival.

The App stimulates young children to want to find out about and learn about the animals and cultures of Africa. Ansel and Clair consider the dangers of being in close proximity to wild animals and can interact with scenes, by for example, turning day into night in the Sahara Desert or changing the rainy season into the dry season in the Serengeti. This is then followed up by changes in the App as some of the animals or items vary the information depending on the conditions (e.g. day or night, or wet v dry season).

The design of this App is very effective and engages the players. The sound effects add ambiance to the scenes. Ansel and Clair are drawn in a different art style, so it's apparent that their alien presence doesn't belong. The games and activities are both fun and entirely appropriate for the age of kids likely to play this app, and they fit into the African theme. All the animals that live in each ecosystem are shown together, even though in real life they would not coexist so peacefully.





**Activities:**

The adventure begins by locating the continent of Africa on a world globe (with the support of an arrow if you take too long!). Once there you can select from the various places that have both graphics and words to inform you what they are called and what you might expect to see there. If, for example, you choose the Nile Delta you arrive to a new screen and Clair tells you where you have landed and that there are missing parts of the spaceship to find. The children are then free to explore in any sequence that they choose and will randomly find space parts.

The exploration is a conversation between Ansel and Clair and their interaction is well captured in a relationship of excitement and curiosity with Ansel asking interesting questions and Clair responding with detailed information. For example, when they tell us about the frogs in the Nile they explain how fascinating they are and provide details of their life cycle that the player can participate in by placing the pictures in the correct sequence in the life cycle. Ansel asks questions about Clair's information. He queries what metamorphosis means and she explains the life cycle and he further asks how they breathe in water without their gills. The additional information provided by the 'light bulb' icon is clearly presented and explained and also provides more questions that could lead to further *off App* investigations.

**STEM Learning Links:**

Concepts - The topic of the ecosystems of Africa (as well of those at home) are relevant to a variety of scientific topics that include geography and a study of living things.

Skills - The skills used in this App directly can help to assist educators and children to stimulate investigations using observations, critical thinking, problem solving and posing, classifying, planning and communicating.

**EYLF:**

- 1 Identity** – self confidence, routines, challenges
- 2. Connectedness** – social / empathy, cooperation, build understandings
- 3. Well-being** – curiosity, inquiry, build relationships
- 4. Confident** – playful explorations, foundational knowledge, new ideas, shared meanings
- 5. Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 2



### *Book Creator*

#### **Summary:**

Book Creator is a resource that enables people to create their own eBooks. Images that you have saved or drawn can be selected and used. New text can be created and placed on pages. Font types and colours can be chosen. Background colours can be selected from a range provided. Music and voice excerpts can be recorded to accompany the text and images on any page.

**Age:** 8+ years (adult scaffolding)

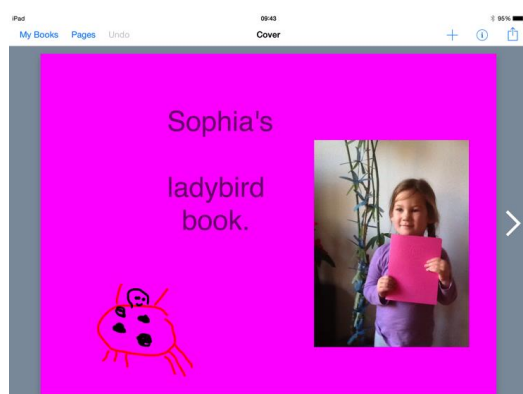
**Price:** \$4.99

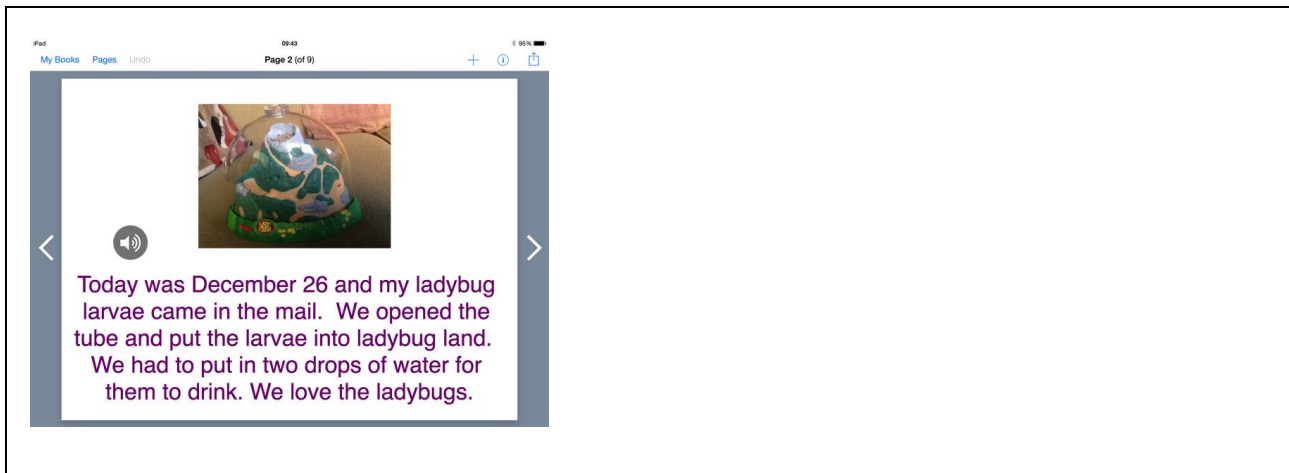
**Source:** Red Jumper

#### **About the App:**

This App allows any images or text to be easily resized to suit the design you want for your page. The process of inserting your multimodal creations into your book are easily completed. The book can be made as long or short as you wish. The ease at which great books can be created, particularly that the children have made for themselves, makes this a must have App.

When the book is completed it can be saved and read in the application. The book can also be sent to the iBooks App where it can be read by scrolling the pages over by turning each page with a flick of a finger. The book can also be saved as a pdf file for printing in hard-copy. This makes it a multimodal experience.





**Activities:**

Making eBooks with early learners is an open ended and creative experience. There is no limit to the type of activities that the children, scaffolded by adults, can embark upon. Activities and content can be related to any topic and encourages thinking skills, design processes and creativity.

**STEM Learning Links:**

Book creator is an App that parents and teachers can use in any way that they wish to link to the concepts and processes (e.g. critical thinking, problem solving and posing, classifying, planning and communicating) that are being investigated.

**EYLF:**

- 1 **Identity** – self confidence, routines, challenges
- 2. **Connectedness** – social / empathy, cooperation, build understandings
- 3. **Well-being** – curiosity, inquiry, build relationships
- 4. **Confident** – playful explorations, foundational knowledge, new ideas, shared meanings
- 5. **Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 3



### *Bugs and Buttons*

#### **Summary:**

A collection of 18 mathematical games, like its companion Bugs and Numbers, that incorporates bugs (ants, bees, butterflies, dragonflies, fireflies, and ladybugs) and the use of buttons (sizes, colours, shapes, styles) in various contexts.

**Age:** 4+ years

**Price:** \$4.49

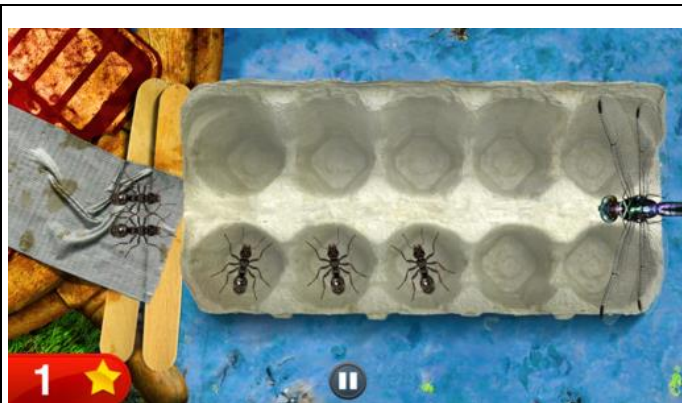
**Source:** Little Bit Studio

#### **About the App:**

The games involve the application of specific foundational mathematical skills. This includes sorting, matching, finding and making patterns and counting. They also go beyond this to playing games that promote spatial understandings and reasoning (e.g tic tac toe) connecting dots to create shapes, navigating a maze, steering a car, and matching, and completing letter sequences. Most of the games incorporate buttons and the bugs in various scenarios. The graphics are very high quality and the games engaging. Voice-overs are available in 14 languages.

When any game is completed successfully the player is awarded a stamp. These can then be placed in a book to form a collection.





### Activities:

There are 16 games that can be selected by scrolling across three screens. They include (bees eyes (trajectories); patterns, counting, tic tac toe, catch 'em (fine motor / counting); button & factory sorting; apple pickin' (counting); connecting dots; bug maze; firefly sky (colours); bug race (fine motor/ speed); pinch & grab (sorting); butterfly valley (tilt the screen to navigate path and collect / count items); find it (hidden bugs under thimbles); matching (capital and lower case letters); letter train (finding missing letters in patterned sequence). The games increase in difficulty as the child becomes more proficient and instructions are available in a diagrammatic format for non-readers.

### STEM Learning Links:

While this App is fixed in its use and practice of basic foundational skills, it has the potential to stimulate interest in the topic of living things and in particular different types of bugs and insects. The graphics are very realistic and children become fascinated with the bug collection as well as playing with buttons for sorting and counting. The use of the App could be linked to an investigation around the topic of 'living things' (see Yelland & Gilbert, 2015) and planning ideas can be created in a 'curriculum web' (see Figure 2 of the body of this report).

Concepts include patterns, cause and effect, systems, living things.

Skills include classifying, sorting, patterns, questioning, problem solving, planning, evaluating.

### EYLF:

**1 Identity** – self confidence, routines, challenges

**2. Connectedness** – build understandings

**3. Well-being** – curiosity, inquiry

**4. Confident** – playful explorations, foundational knowledge, new ideas, shared meanings

**5. Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 4



### *MadPad*

#### **Summary:**

MadPad enables a (4x3) montage of pictures and sounds to be created and replayed. The innovative users of MadPad remix the everyday sounds into percussive and melodic beats and loops that are repeated until they are satisfied. In using MadPad, everyday sounds, like a car door slamming shut, or the rustling of newspaper pages, are turned into a melody. The App challenges everyone to dream up creative ways to mix various and surprising combinations of sounds to generate new ways of hearing them!

**Age:** 4+ years (adult scaffolding)

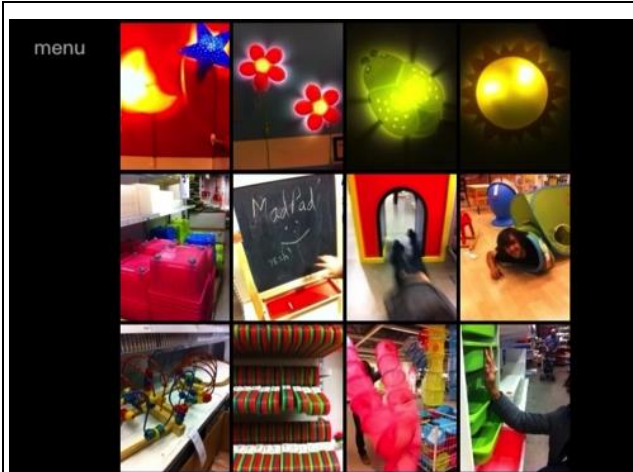
**Price:** \$4.99

**Source:** Smule

#### **About the App:**

When trying something new its always good to see an example of how it works. Then you can use it as a model to produce a new version. MadPad enables users to view and play with other users' range of MadPad creations that are already saved on the Internet and shared on YouTube. In one example, there are a series of 12 photos and sounds related to aspects of a car arranged in the matrix. In others there are various scenes and sounds from daily lives (e.g. a piano, bobble head toys, airport sounds) as well as others using a range of musical instruments. The idea is that the clips are 'short and snappy' and can be played individually, but also adapted so that they form a range and sequence which is new. This enables young children to play and innovate with natural sounds. It is a whole lot of fun and lifts creative potential with each use so that each time it is a different experience.





### Activities:

Each one of the 12 'boxes' lets you record a 10 second video/ audio and when all 12 have been completed they can be 'tested' and saved for use. In this way MadPad is as useful as you want it to be.

### STEM Learning Links:

Because it is 'open ended' MadPad can be applied to any investigation. For example, the sounds in the kindergarten playground or an introduction to each person in the kinder group.

In recording and replaying the sets, early learners become more attuned to sounds that exist around them and also have a creative time mixing the sounds to generate new *eSounds* that are an interesting mix of sounds we take for granted.

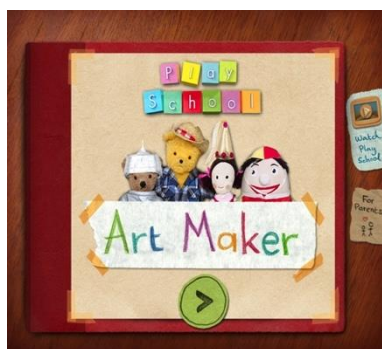
Concepts – Any matrix that you wish can be created and to give you ideas you can scan the examples that are already save by browsing the internet to find good ones. They cover a very wide range of possibilities to inspire you. [ e.g. patterns, cause and effect, scale, systems, energy, structures and forces, change, living things and the earth and ecosystems

Skills – In using MadPad a wide range of skills can be supported with effective scaffolding from the educator [ e.g. observing/ describing. Classifying/ sorting, questioning, predicting/ explaining, problem solving and posing, interpreting (data), communicating, planning, applying maths and science thinking practices, designing solutions, evaluating.

### EYLF:

- 1 **Identity** – self confidence, routines, challenges
2. **Connectedness** – social / empathy, cooperation, build understandings
3. **Well-being** – curiosity, inquiry, build relationships
4. **Confident** – playful explorations, foundational knowledge, new ideas, shared meanings
5. **Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 5



### *Play School Art Maker*

**Summary:**

Play School Art Maker is an open ended and creative App that enables children to construct scenarios with their favourite Play School characters. These scenes can then be transformed into videos with a click of the camera - with the child telling their story into the microphone. Telling stories, creating and communicating narratives are an essential part of becoming literate and this App facilitates this process in a digital form that can complement story making in real world contexts.

**Age:** 2-6 years

**Price:** \$2.99-\$4.99

**Source:** ABC

**About the App:**

The App has six backgrounds settings (beach, farm, moon, bedroom, kitchen, underwater) and 16 coloured backgrounds. It is also possible to import your own photos from your camera roll.

Scenes are created by using the features of the App that include the Play School regulars of Big and Little Ted, Jemimah, and Humpty. They are supplemented with animals and items that specifically will be found in each location; whether this be a farm, beach, underwater or another planet. Of course, the child can also decide not select a background and simply use a colour or a blank (white) space. This App stimulates creativity in a package that enables them to play and explore with characters and scenarios that are of interest to them. There are many choices and minimal limitations to this exploration apart from the obvious link to Play School.

Once completed the pictures/ animations can be saved to the photo album and exported as pdf files. While using the App the children can be accompanied by music and there are voice overlays to support the creations with suggestions.

For Australian users of the App there is also the option to watch selected episodes of the program, which can be attractive to parents who want high quality early childhood programs for homes.





**Activities:**

Play School art maker offers children many possibilities to follow their interests by providing a context for them to record and save their playful explorations. For example:

- Creating narratives around different themes (e.g. farm, beach) that include relevant items and materials with their favourite characters from Play School.
- Investigations in each context created by (for example) thinking about the sounds that animals make and classifying items that belong in different scenarios.
- Providing contexts in which educators can talk to children using the basic mathematical vocabulary associated with positions and relationships terms (e.g. up/ down, above/ below, near/ far...)
- Turn stories into animations with the movie feature and their own audio narration
- Extend their stories when not using the App to write and draw further 'chapters' in the episodes.

**STEM Learning Links:**

The Play School Art Maker App can support investigations about any number of topics or projects that children self select or become part of because of the natural curiosity of the group. It is open ended to the extent that the children can create scenarios and explore what they wish, but it has limitations in that the characters and items are fixed within the Play School context. It has the potential to encourage children to create oral narratives that can be animated with the video camera and this is very attractive for pre-writing children who have an active imagination.

Multiple skills are used in the creation of the scenario and educators will be able to support early learning in their scaffolding and interactions with the children as they use and complete narratives in this App. They will include using observations, critical thinking, problem solving and posing, classifying, planning and communicating.

**EYLF:**

- 1 Identity** – self confidence, routines, challenges
- 2. Connectedness** – social / empathy, cooperation, build understandings
- 3. Well-being** – curiosity, inquiry, build relationships
- 4. Confident** – playful explorations, foundational knowledge, new ideas, shared meanings
- 5. Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 6



### *Sago Mini Robot Party*

#### **Summary:**

The App is set in the context of designing a robot to go to a party. Once the player has designed the robot they can take it to the party and play with cupcakes, musical instruments, streamers and a piñata, which are all controlled by the player pressing the buttons located on the screen.

**Age:** 5 years and under

**Price:** \$4.49

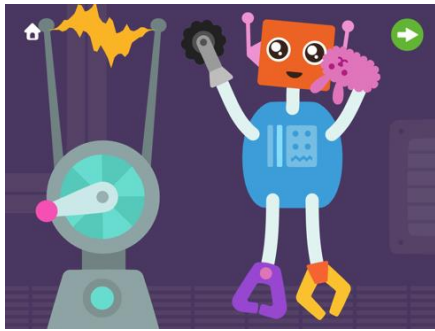
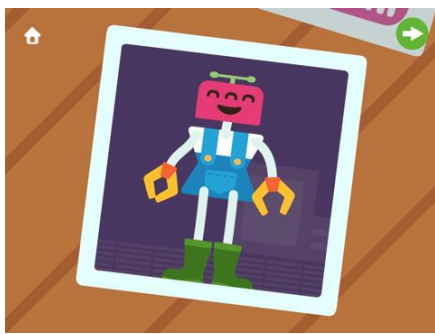
**Source:** Sago Sago

#### **About the App:**

Photos can be taken of the robot and can also be imported from personal devices. There is a repeating digital music soundtrack that can be turned off - but if it is - then the instruments are also silent which negates the effectiveness of the game. The soundtrack would interfere with conversation between the player and scaffolding adult; and it does interfere with the sounds of the musical instruments. There are also other Sago products advertised through pop-ups but these can also be turned off via Settings.

There is a clearly written guide addressed explicitly to parents (not carers nor teachers); and also a picture of a 'stereotyped' scientist at the beginning and the end wearing a white coat. The robot is gender neutral but children to choose colour and clothing if wanted.





#### Activities:

Children have a choice of body, heads, hands, feet and clothes, all ‘wacky’ and robot-like. There are no restrictions on numbers of heads, hands etc. and shoes and socks - might or might not - match each other or match right and left feet . After designing the robot, it is wound up by turning a handle to give it energy and off it goes in party mode to ice and sprinkle cupcakes, play a drum or trumpet or rattle or ring a bell. The robot ices cup cakes and plays with balloons that burst, a piñata and streamers by pressing buttons on the screen. At the end the player can choose to take a photo of the robot.

#### STEM Learning Links:

There is plenty of opportunity to engage in playful conversation about the choices the child makes and to highlight ideas of cause and effect, right and left. The content is explicitly robotic, with control technology.

Concepts include patterns, cause and effect, energy, structures and forces, change.

Skills include classifying/ sorting, predicting, interpreting, communicating, planning, applying science thinking practices, designing solutions, colour and pattern recognition

#### EYLF:

- 1 **Identity** – self confidence, routines, challenges
2. **Connectedness** – social / empathy, cooperation, build understandings
3. **Well-being** – curiosity, inquiry, build relationships
4. **Confident** – playful explorations, foundational knowledge, new ideas, shared meanings
5. **Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 7



### *Sock Puppets Complete*

#### **Summary:**

This is a creative App that invites players to design puppets ('sock characters'), locate them in a setting, and then use them to tell a story. The child chooses the characters, the costume and the settings from several alternatives. There is also the option of including their own designs, some of which can occur simultaneously. The child can then use the puppets to tell a story that the characters play out.

**Age:** 4+ years (adult scaffolding)

**Price:** \$5.99

**Source:** Smith Micro Software

#### **About the App:**

To tell the story the child uses the recording function of the device, manipulating their own voice to animate the characters and the set and props, all of which can move. The story is then played back and can be saved.

The possibilities for using this storytelling play device go beyond the invention and narration of the story using the App – for example it could be used to discuss ethical issues with children.

There is a good tutorial for adults created using the App – it isn't long but it indicates the scope and range of the App, and can be either watched on screen, or read.

The child is indirectly invited to project their identity onto one or more characters. The child can control gender and skin colour in the design of puppets.



**Activities:**

To begin a play scenario the first step is to choose character(s). There are a range of possibilities with characters that resemble humans and animals in some way. The next screen has corresponding backdrops and there can be up to four of these selected. They can be incorporated into the story, e.g. night turns to day; indoors goes to outdoors. The next page has options for props and scenery related to the theme chosen. Then the stage is set the characters are ready to be animated.

At this stage the child turns on the recording device and speaks. Touching a character gives voice to that character. The character 'remembers' movement too, so manipulating position whilst speaking plays back as the character moving around. Similarly some of the backdrops and props can be made to move as well, and so incorporated into the narrative.

**STEM Learning Links:**

There is image making, music, movement, recording, and story telling.

Concepts include cause and effect, scale, systems, structures and forces, change, living things and the earth and ecosystems.

Skills include describing, questioning, predicting/ explaining, problem solving and posing, communicating, planning, designing solutions, and evaluating.

**EYLF:**

**1 Identity** – self confidence, routines, challenges

**2. Connectedness** – social / empathy, cooperation, build understandings

**3. Well-being** – curiosity, inquiry, build relationships

**4. Confident** – playful explorations, foundational knowledge, new ideas, shared meanings

**5. Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 8



### *Tally Tots Counting*

#### **Summary:**

This is a simple app that focuses on counting from one to twenty. There is no opportunity to trace digits with fingers, but otherwise tactile experimentation with cardinality is encouraged, e.g. watch three mice run by setting them off, play a tune on eight bottles, pick sixteen cherries from two trees and load them on to a cart.

**Age:** 5 years and under

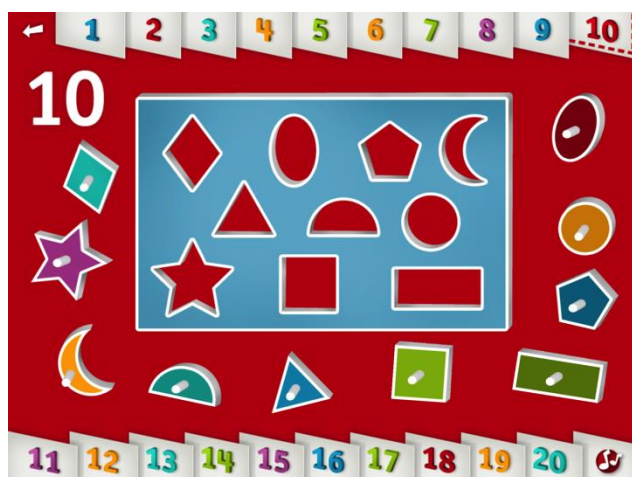
**Price:** \$4.49

**Source:** Spinlight Studio

#### **About the App:**

Ordinality is encouraged through counting on and back. It is possible to engage with order and cardinality separately. Formal language is used and praise offered – e.g. matching shapes to holes correctly elicits ‘you are good with shapes’ from the (female American) voice.

The focus on number invites close attention from an adult or another child and could be used for conversations about number, numerals and quantities. There is no pedagogic guidance for adults. Pop-ups on the entry page advertise other Apps from Spinlight.







### Activities:

On the entry page the child chooses either a song or 1,2,3. There are no instructions about how to play with the song first but the left hand positioning would suggest to a Western adult that this is the natural order.

The song 'Let's all count with Tally Tots' with guitar accompaniment, counts up to twenty with pictures to go with each number. A number can be selected by touch and there is an interactive illustration that encourages tactile engagement with the cardinality of the number. When you touch the numeral the number name is heard. The illustrations are bright and cartoon in character.

### STEM Learning Links:

The App enables young learners to play with numbers from 0 to 20. It focuses on the foundational skills of counting, recognising numerals and number names, and a consideration of number names in sequence.

The activities can be used as a catalyst for exploration. For example the items in the counting sequence can have follow up questions; can you see an airplane in the sky? What happens to the three blind mice? Can you make up a tune on eight bottles?

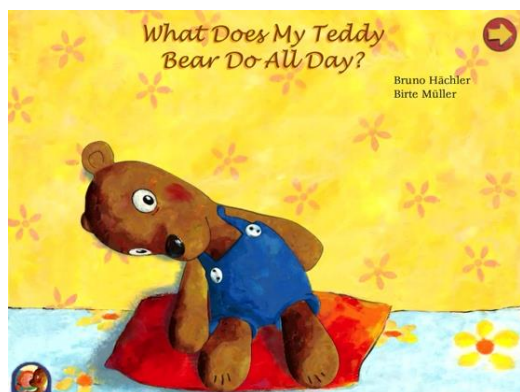
Concepts include patterns and systems.

Skills include observing, problem solving, applying maths thinking practices, and early pattern recognition

### EYLF:

- 1 **Identity** – self confidence, routines, challenges
2. **Connectedness** - build understandings
3. **Well-being** – curiosity, inquiry
4. **Confident** – playful explorations, foundational knowledge, new ideas, shared meanings
5. **Communicators** – build language, multimodal, interpretations

## STEM App Review 9



### *Teddy's Day*

**Summary:**

The contextual concept for this story is a little girl questioning what her teddy does all day when she's out at school. She's sure he moves when she isn't looking so one day she spies on her teddy. Being unable to catch teddy moving, she decides it would be a good idea to tempt him with honey which she knows he will not be able to resist. Her plan works and Teddy takes the bait and in the process is immobilised by stomach ache.

**Age:** 4+ years

**Price:** \$2.99

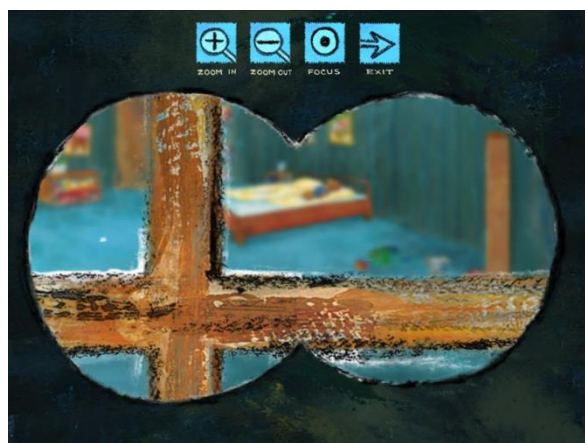
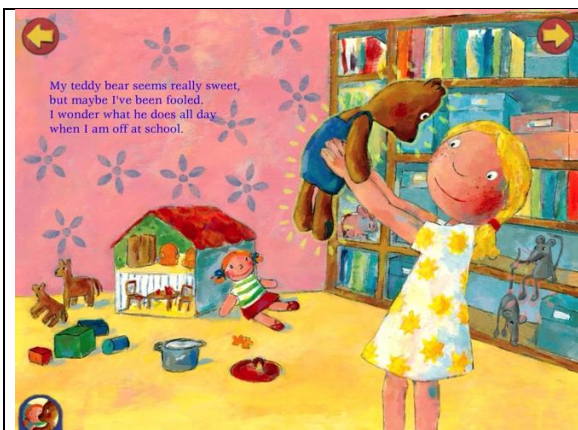
**Source:** Auryn

**About the App:**

This features a girl (blond, white) as a confident enquiring investigator with systematic and determined tendencies. This is a well-crafted stand-alone intelligent narrative that mixes science fact with science fiction. Illustrations are intricate and on each page there is something interactive for the player to explore. The spoken words are also printed out on each page, making this suitable for children with hearing and visual challenges.

Available in four languages, American English, German, Chinese and Thai.

There is no guidance for adults, and there are no pop-up advertisements. At the end is a screen addressed to the player whether they would like more of this kind of book and a link which requires birth year to be entered manually.



**Activities:**

Designed like a pop-up book, each page has a question framed in verse. Does teddy sit around all day or move around? A ticking clock has an alarm that goes off and that sets off a sequence for teddy. Questions are posed: Does he listen to music and dance with the doll? The music is dance music and also it is possible to focus on the sound of a clarinet and snare drum.

The little girl decides to stay at home and spy on teddy, determined to catch some action. She has an incomplete jigsaw for the player to finish, and a screen to draw on using different sized line and different colours. Once the player has drawn a picture it goes on the wall.

During afternoon nap teddy sneaks a blink. The little girl looks through the keyhole and sees teddy asleep. The graphic keyhole increases in size as the child looks through it; the little girl is, in turn spied on by her doll. Climbing a tree from outside the house the girls uses binoculars (with 'Zoom and + and – buttons) to look through her bedroom window. 'You wait, I'm going to catch you' she says. But teddy seems to know that he's being spied on and even tempted by his favourite TV shows – complete with remote to change the station – he doesn't move. Until that is the honey is brought out as a last resort temptation that the little girl is pretty sure will work. At this point teddy disappears and hides, presumably with the honey, until it is all gone and he has a tummy ache.

**STEM Learning Links:**

The App includes a TV remote, binoculars, puzzles, game playing, drawing, colour, music and philosophical questions of existence!

Concepts include cause and effect, scale, change, living things, symbolic instructions.

Skills include observing/ describing; questioning, predicting/ explaining, problem solving and posing, interpreting (data), communicating, planning, applying maths and science thinking practices, evaluating.

**EYLF:**

**1 Identity** – self confidence, routines, challenges

**2. Connectedness** – social / empathy, cooperation, build understandings

**3. Well-being** – curiosity, inquiry, build relationships

**4. Confident** – playful explorations, foundational knowledge, new ideas, shared meanings

**5. Communicators** – build language, multimodal, interpretations, narrative/ stories

## STEM App Review 10



### *Thinkrolls 1*

#### **Summary:**

This App is a visual/spatial game that enables the player to explore a maze-like environment to reach a goal. There are obstacles on the way that need to be considered and overcome in order to move forward. The concepts of 'up, down and side to side' are important for navigating the pathway and the order in which obstacles are dealt with becomes increasingly complex.

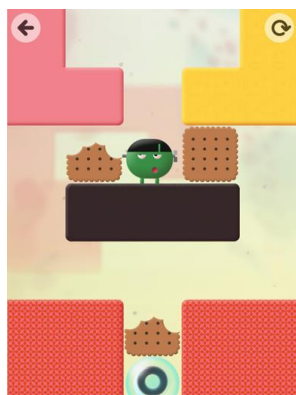
**Age:** 3-8 years

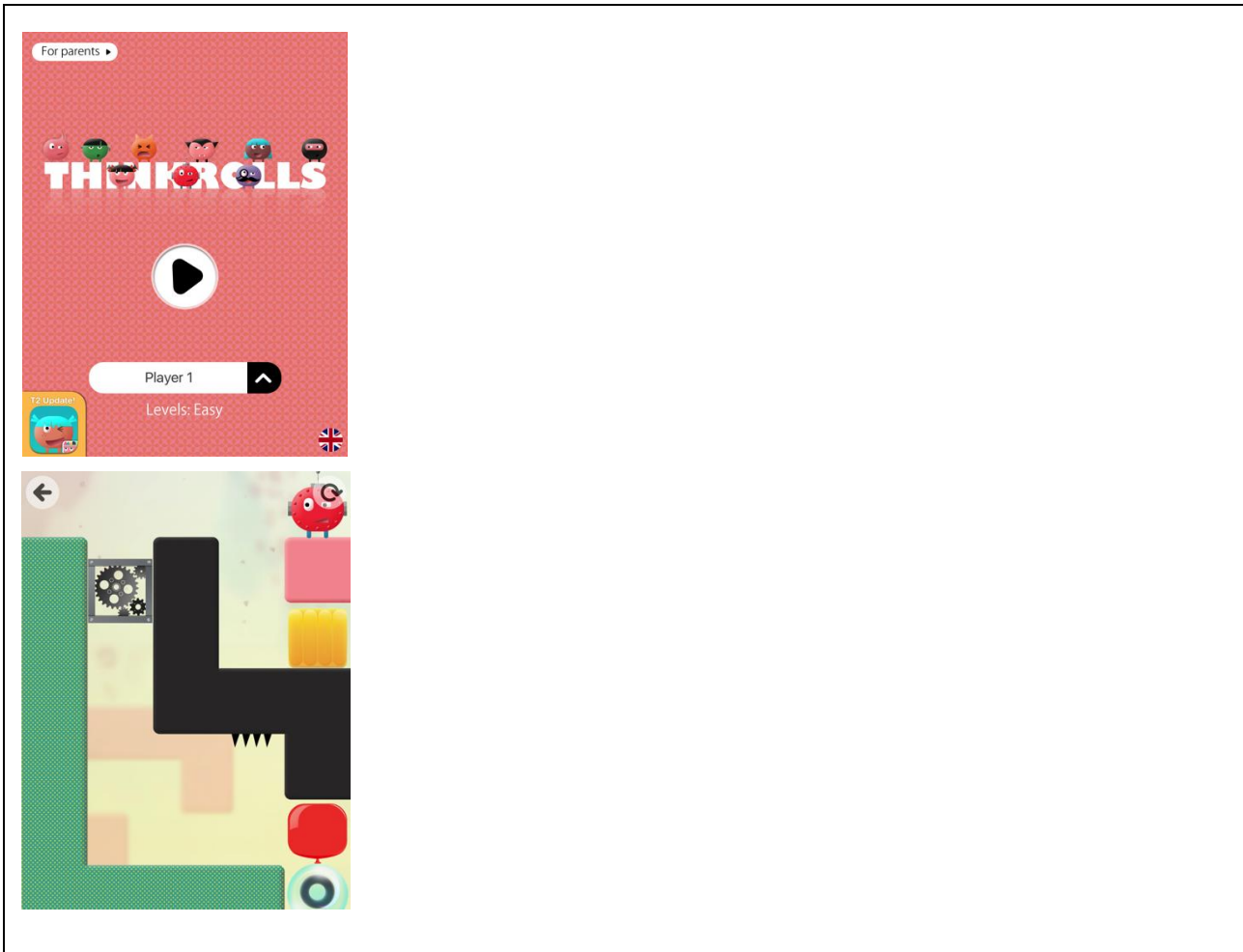
**Price:** \$5.99

**Source:** Avokiddo

#### **About the App:**

There are in-app settings for adults to control level of difficulty and to turn 'Super Mario'-type music on or off. There is no advertising of other Avokiddo games except by request, when an adult clicks 'About us'. The 'easy' level is aimed at ages 3-5 year olds and 'hard' is recommended for ages 5years+. There are over one hundred levels for each stage of difficulty. The App is available in 18 languages including both UK and US English, but there is no speech or text in the games, only in the text instructions to adults. The child is indirectly invited to project their identity onto their character. Gender and skin colour are under the child's control in terms of the design of the game.





**Activities:**

The players – there can be up to nine at different levels of difficulty – choose a character icon and start to roll through a maze. Gradually challenges are introduced that close off routes and the player has to work out how to open up a route that works. If the player makes a mistake then the back button resets to the beginning of that particular challenge. The challenges include a cookie that must be eaten, a gate that must be moved right or left, a balloon that goes up and bursts, a rock that needs to be moved and used as a tool to crack open a blocked opening, a bouncy spring to gain height, a fire that must be extinguished by smothering it with a smothering block, a machine that needs to be wheeled away.

**STEM Learning Links:**

The App encourages mathematical thinking, ordering, and inductive and deductive reasoning.

With the assistance of an adult asking questions that extend thinking beyond the App, game use could be linked to investigations of maps and planning routes and even related to changing plans. The children might reflect on journeys that they have made using various forms of transport such as air, roads and walking paths. Design thinking occurs as players control the attributes of the character and make decisions about the course to be taken.

Concepts include patterns, cause and effect, scale, elemental systems, energy, structures and forces.

Skills include observing/predicting/ problem solving and posing, interpreting (data), planning, applying maths and science thinking practices, designing solutions, evaluating.

**EYLF:**

**1 Identity** – self confidence, routines, challenges

**2. Connectedness** – social / empathy, cooperation, build understandings

**3. Well-being** – curiosity, inquiry, build relationships

**4. Confident** – playful explorations, foundational knowledge, new ideas, shared meanings

**5. Communicators** – build language, multimodal, interpretations, narrative/ stories

Appendix 3: Mapping Matrix - 4-5 year old iPad STEM Apps to the Early Years Learning Framework

| APP NAME                                | IDENTITY        |          |            | CONNECTEDNESS   |             |                      | WELL BEING |         |                     | CONFIDENT            |                        |           |                 | COMMUNICATORS  |            |                 |                     |
|---|-----------------|----------|------------|-----------------|-------------|----------------------|------------|---------|---------------------|----------------------|------------------------|-----------|-----------------|----------------|------------|-----------------|---------------------|
|   | Self Confidence | Routines | Challenges | Social/ Empathy | Cooperation | Build Understandings | Curiosity  | Inquiry | Build Relationships | Playful Explorations | Foundational Knowledge | New Ideas | Shared Meanings | Build Language | Multimodal | Interpretations | Narratives/ Stories |
| 123 Kids MA by Mintomeg                 | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          |         |                     |                      | ◆                      | ◆         |                 | ◆              |            | ◆               |                     |
| Ansell and Clair's Adventures in Africa | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Blaze and the Monster Machines          | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          |         |                     | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               | ◆                   |
| Book Creator for iPad                   | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Bugs and Numbers                        | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Bugs and Buttons                        | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          |         |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Playtime With Dora the Explorer         | ◆               | ◆        | ◆          |                 | ◆           | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               | ◆                   |
| eBook – Peekaboo Forest                 | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| eBook – Steam Train                     | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| eBook – Teddy's day                     | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Eggy Time                               | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Explore Daniel Tiger's Neighborhood     | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               | ◆                   |
| Friendly Shapes                         | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               |                     |
| Imotion/ imovie                         | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Kids Farm Animal jigsaw Puzzles         | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          |         |                     |                      | ◆                      | ◆         |                 | ◆              | ◆          |                 |                     |
| Lumikids Backyard                       | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               | ◆                   |
| Lumikids Park                           | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               | ◆                   |
| MadPad                                  | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| More Fun With Directions HD             | ◆               | ◆        | ◆          |                 | ◆           | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |



|  | IDENTITY        |          |            | CONNECTEDNESS   |             |                      | WELL BEING |         |                     | CONFIDENT            |                        |           |                 | COMMUNICATORS  |            |                 |                     |
|--|-----------------|----------|------------|-----------------|-------------|----------------------|------------|---------|---------------------|----------------------|------------------------|-----------|-----------------|----------------|------------|-----------------|---------------------|
| APP NAME                                 | Self Confidence | Routines | Challenges | Social/ Empathy | Cooperation | Build Understandings | Curiosity  | Inquiry | Build Relationships | Playful Explorations | Foundational Knowledge | New Ideas | Shared Meanings | Build Language | Multimodal | Interpretations | Narratives/ Stories |
| Nighty Night Farm                        | ◆               | ◆        | ◆          | ◆               |             | ◆                    | ◆          |         |                     | ◆                    | ◆                      | ◆         |                 | ◆              |            | ◆               | ◆                   |
| Phone for Kids                           | ◆               | ◆        | ◆          |                 | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    |                        | ◆         |                 | ◆              | ◆          |                 |                     |
| Play School Art Maker                    | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Play School Play Time                    | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Presto Bingo Shapes                      | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     |                      | ◆                      |           |                 | ◆              | ◆          |                 |                     |
| Sago Mini Pet Café                       | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          | ◆               |                     |
| Sago Mini Robot Party                    | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Shiny Party - Shapes & Colors            | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          |                 |                     |
| Simple Machines by Tinybop               | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Sock Puppets                             | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Sorting for Early Science                | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Stellarium Mobile Sky Map                | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| TallyTots Counting                       | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Tap Number by Mintmomeg                  | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Tap Transport by Mintmomeg               | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       |                     | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| The Earth (Tinybop)                      | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| The Infinite Arcade by Tinybop           | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| The Wheels On The Bus                    | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Thinkrolls 1 and 2                       | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Tiggly Chef: Preschool Math Cooking Game | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |

|                                 | IDENTITY        |          |            | CONNECTEDNESS   |             |                      | WELL BEING |         |                     | CONFIDENT            |                        |           |                 | COMMUNICATORS  |            |                 |                     |
|---------------------------------|-----------------|----------|------------|-----------------|-------------|----------------------|------------|---------|---------------------|----------------------|------------------------|-----------|-----------------|----------------|------------|-----------------|---------------------|
| APP NAME                        | Self Confidence | Routines | Challenges | Social/ Empathy | Cooperation | Build Understandings | Curiosity  | Inquiry | Build Relationships | Playful Explorations | Foundational Knowledge | New Ideas | Shared Meanings | Build Language | Multimodal | Interpretations | Narratives/ Stories |
| TinyHands What's My Pair 2      | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Toca Blocks                     | ◆               |          | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          |                 | ◆                   |
| Toca Lab                        | ◆               |          | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         |                 | ◆              | ◆          |                 | ◆                   |
| Toca Town                       | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |
| Toddler Playtime Pack           | ◆               | ◆        | ◆          |                 |             | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               |                     |
| Video touch (movies of animals) | ◆               | ◆        | ◆          | ◆               | ◆           | ◆                    | ◆          | ◆       | ◆                   | ◆                    | ◆                      | ◆         | ◆               | ◆              | ◆          | ◆               | ◆                   |

## Appendix 4: A Kindergarten Learning Story

| <b>Learning outcomes</b>   | <b>Examples or cues to demonstrate this</b>   | <b>A Learning Story</b>   |
|--|---|---|
| <b>Children have a strong sense of identity</b>                  | <ul style="list-style-type: none"> <li>• feels safe, secure and supported</li> <li>• develops their emerging autonomy, inter- dependence, resilience &amp; sense of agency</li> <li>• develop knowledgeable and confident self identities</li> <li>• learn to interact in relation to others with care, empathy and respect.</li> </ul> | The children (5 boys) showed an interest in the sounds and pictures from <i>MadPad</i> sets stored on the iPad. After demonstrating the features to them we talked about what sounds we could make with our bodies. Allan said “what about this sound?” and made a clicking noise with his tongue. “What about clapping?” asked Brendan as he did the motion. |
| <b>Children are connected with and contribute to their world</b> | <ul style="list-style-type: none"> <li>• Sense of belonging to group</li> <li>• Respect diversity</li> <li>• Recognise fairness</li> <li>• Socially responsible</li> <li>• Show respect.</li> </ul>   | We then walked around thinking about other sounds we could make with objects around us. Allan stood on the swing and said “Look at this sound!” He picked up two pots in the sandpit and began banging them together. “We can use this sound!” Later, when entering the sounds the boys made sure everyone had a turn.  |
| <b>Children have a strong sense of wellbeing</b>                 | <ul style="list-style-type: none"> <li>• Strong social &amp; emotional well being</li> <li>• Increasing responsibility for own well being</li> </ul>  | The boys were able to find an array of sounds to use for the mad pad collection and we recorded the video of them making the sounds in two sets. They were able to recognise what sounds would work and which ones were too soft – since in the playground noise levels tend to be elevated.  |
| <b>Children are confident and involved learners</b>              | <ul style="list-style-type: none"> <li>• Develop dispositions for learning</li> <li>• Skills of learning – exploring &amp; investigating</li> <li>• Transfer across context</li> <li>• Resource own learning in variety of contexts</li> </ul>  | The group was able to take turns and listen to each other and share their sound discoveries. They waited while some technical difficulties around recording sound levels were fixed and then played back the sounds for each other to listen to.  |
| <b>Children are effective communicators</b>                      | <ul style="list-style-type: none"> <li>• Interact with others</li> <li>• Engage with range of texts &amp; make meaning</li> <li>• Express ideas in range of media</li> <li>• Use symbols to express ideas</li> <li>• Use ICT for learning.</li> </ul>   | The <i>MadPad</i> sets contained the sounds that the boys made outside in the play areas. They waited while this process took place and shared their final products with their peers – explaining how they made it as they played the sets of pictures and sounds.  |

### Short term review

This App was open ended so that the children were able to create their own sets using the photos and sounds around them. They were confident in their approach to the task and sustained interest over a lengthy time span that involved some technical difficulties. Creating the 'local' sets enabled them to feel connected to their environment from a different perspective and think about the various sounds and images that are connected in our daily lives.

Source: Yelland & Gilbert (2014), (Adapted from Carr, M. (2001). *Assessment in early childhood settings: Learning stories*. London: Sage.



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