Technology and literacy in a synergy: Understanding children techno-literacy for e-book design

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Abstract

Previous studies have demonstrated children high inclination with technology has drifted them apart from reading as well as physically visiting library. Therefore this study is conducted to converge technology and literacy as a synergy towards understanding children techno-literacy particularly with e-book intervention to inform about e-book design that children would want to engage with. This study reports a descriptive study of young children engagement with e-books conducted in preschool classrooms. It focuses on landscaping a methodical framework for observing children engagement with e-books in different formats. Videotaped observation is employed to investigate children interaction and engagement with-books from classroom samples (n=18 children). A framework of children engagement with e-books was derived using qualitative systematic procedures. The framework consists of three categories (multisensory behaviors, communication and emotion) and eight main behavior of children engagement with e-books. The framework is then compared between two different types of e-books (interactive e-storybooks and educational e-books) to obtain descriptive observation of children engagement. Behavior regulation levels and its possible influences on children engagement with e-books are also explored. This is a preliminary phase of a bigger study to investigate techno-literacy of young children to theoretically inform and enhance children e-books design. The findings of this study would further provide insights on how children library services would be redesign to inculcate a growing society who is technology savvy.

Keywords

e-book, young children, engagement, apps, design, emergent literacy

1. Introduction

Literacy generally means ability to read and write, while the term technoliteracy broadly can be defined as the state of being conversant with modern technology or technology engagement. In this, technology encompasses the computer, information, mobile phone, critical media, multimedia and etc. Burnet (2010) in her review paper of technology and literacy in early childhood view technology as: deliverer, interaction platform and medium of meaning making. Therefore for the purpose of this study technoliteracy refers to being engaged with technology in the form or e-books or mobile applications.

The impulsive growth of children's e-books in the recent years is driven by mobile development where most of the e-books are available through mobile application (apps). As of March 2013, there are approximately 70 billion apps available for download (Pure Oxygen Lab 2014). Over 80% of the top selling paid apps are in the education category targeted at children (Shuler, Levine & Ree, 2012). E-books are frequently held to be beneficial and useful for children's education.

In addition to that, several studies have reported the usage of e-book interventions and young children's literacy development. The findings however are not quite compelling. Some of the studies conclude with a positive outcome that e-books could support learning, comprehension level, and vocabulary development (De Jong and Bus 2004 and Chau, 2008). On the other hand, other studies report otherwise, such as animations distracting reading comprehension and diverting children's attention away from learning (Korat and Shamir 2007, Grimshaw et al, 2007).

Although a number of studies have been conducted to investigate e-book and child interaction, many of these studies report discrepancies in their findings due to the variability in sample size focusing more on older children in the second to fourth grade (Hutchion, Beschorner and Schnidt-Crawford, 2007; Jones and Brown 2011; Larson 2010; Roberts and Barber 2013), and various research designs for a specific e-book software and e-reader (Larson, 2010 and Wijekumar, Meyer and Lei, 2012). These suggest the need for more studies to gauge the gap. Therefore this study was conducted to provide evidence on young children (preschool) who are just starting to learn to read and at the early stage of their emergent literacy. This study aims to investigate young children's active engagement with e-books, to provide insight on how they behave when interacting with e-books rather than just for play and entertainment, and what type of e-books are suitable to foster children's emergent literacy, then later inform what e-book features make children want to engage with them. This is particularly useful to articulate e-book designs for e-book publishers as well as providing guidelines for parents, teachers, and librarians in selecting high quality e-book interventions for home, classroom, and library usage.

1.1 Literature Review

1.1.1 E-Book for Children

The term e-book is generally referred to as an electronic version of a printed book that can be read on a personal computer, or hand held device such as Kindle and IPad. However, Henke (2002) in his e-book survey reports users frequently viewed e-books as dedicated reading devices and not as the associated content. On the other hand,

other researchers have not separated the e-book definition from its hardware as a device used to read, software as a platform to run the application, and document content as the digital publication mainly because they compliment each other (Lynch, 2001; Rao, 2003; Armstrong, Edwards and Lonsdale, 2002; Wilson and Landoni, 2001; and Chen, 2003).

The e-book, which was previously seen as an electronic version of a printed book, has now evolved to provide additional media as an extra dimension (Maynard, 2010) to encourage its usage, taking advantage of the advancement in tablet pc and mobile applications. Morgan (2013) described multimodal e-books as interactive electronic resources that combined text with sound, animation, and images and often include read aloud features and highlighted text for various reading experiences.

In general e-books can be categorized into three types: gaming applications with interactive features; creating application provides tools for drawing, tracing and building; and e-storybook application offering colorful, animated and interactive features often with read to me and game options (Michael Cohen Group and USDOE, 2011; Murray and Olcese, 2011).

Most recently, when the e-book market was predominantly driven by mobile development such as smart phones and tablets, most of the e-books were available in mobile application format, also known as apps. Itzkovitch (2012) distinguishes apps and e-book interventions through their formats: i) apps are running through IOS and Android software; ii) eBooks as in open standards EPUB and Mobipocket (.mobi); and iii) enhanced eBooks as such in ePUB3 format for iBook (Apple) and Kindle format 8 (KF8) for Kindle Fire (Amazon). For the purpose of this study e-books are defined as 'a digital publication consisting of text, multimedia and interactive content that can be read in personal computers and tablets.'

E-books, as new education interventions, have now become more popular in supporting early literacy development among children. This is elevated with the rise of tablet-based computers such as Apple's IPad that supports the use of e-books, also known as apps. In addition, Shuler (2012) in her report claims 80% of the top selling paid apps in ITunes store was in the Education category targeted at children. Apps for preschoolers are the most popular category with 58% and experienced the greatest growth of 23%.

1.1.2 E-book and emergent literacy

According to Chall (1983) early stages of children's reading development involves pre-reading (for preschool) and initial reading and coding (for 1st grade and beginning of 2nd grade). In pre-reading, children are unable to read but they pretend to do so by retelling a story read to them, and they are supposed to be able to name letters of the alphabet, recognize signs, and print their own names. Reading aloud has been found to be one of the most effective forms of teaching children to read because it is a useful technique in promoting independent learning (Gibson 2008). This is specifically made possible in e-book applications with 'read to me' option.

In the initial reading stage, children learn the relationship between letters and sounds, printed and spoken words, read simple texts containing high frequency words, phonically regular words, and use skills to make the sound of new one syllable words. Interactive e-book design provides cross modal (visual – verbal) associative learning to foster letter-sound knowledge, phonemic awareness, and print recognition. In addition, Pearman and Lefever-Davis (2006) promoted e-books as useful for addressing each of the five elements identified by the National Reading Panel as essential for reading development: phonemic awareness, phonics and concepts about print, fluency, vocabulary, and comprehension.

The massive development of e-book apps in the market that frequently advertises them as "educational" and deems to provide educational value to children, opens up opportunities for studies to investigate children's interaction and engagement with the e-book interventions. Engagement is a people's choice not to be told to do or assigned to do. It is motivated by interesting activities, socially useful or personally enjoyable to individuals, and within their zone of proximal development (Marcum, 2000). Likewise, Marks et al. (2013) defines engagement as "emotional, behavioral, and cognitive evidence of students being actively involved in the academic experience". According to Mangen (2010) children's interactions with any technology is a multisensory action as a result of action (for example, clicking with a mouse; swiping the screen, tapping keys on a keyboard) and perception (audio-visual effects of the input, presented on a screen). This is especially useful when e-book interventions provide both action and perception to facilitate new learning experiences of young children that is more engaging and enjoyable. Several studies have supported this premise, such as Shamir and Baruch (2012), who report that interaction with e-books as computer-based activities could develop the motivation of children to learn through variety of multimedia representations such as text, oral narrations, animations, and illustrations. Moody (2010) furthermore indicates features of e-storybooks could assist children with word recognition skills by enhancing print using highlighting words and sentences together with read aloud facilities. Similarly, Shamir and Baruch (2012) report children's improvement, both in their vocabulary and early math skills when using e-books.

On the other hand, Chiong et al. (2012) find that children recall fewer details when using enhanced e-books because they are often too busy with the additional features such as games and hotspots. Their research indicates that enhanced e-books distract children from the story and disrupt their memory of narrative details, contrary to what happens with print versions and with textual e-books based on the same story. Mangen (2008) also reports intangibility of the digital text has caused the reader to have shallower and less focused reading experience.

1.2 Research Questions

The main objective of this study is to investigate children's (age 4-6 years old) engagement with e-books. The research questions are:

- What are the prominent indicators of children's engagement with e-books?
- How does the type of e-book influence children's engagement? (interactive e-storybooks and educational e-books)
- How have different settings (independent vs shared setting), gender (female vs male), and age groups (age 4-6) affected children's engagement with e-books?

2. Research Method

A descriptive research approach was used to observe children's engagement with e-books in a preschool classroom in September 2013. The emergent behaviors of children's engagement with e-books were observed, drawing on existing categories and other behaviors that might emerge frequently from observations on participants.

Prior to the data collection session, consent letters were distributed to parents to obtain their approval for their children to participate in the study. A questionnaire was also distributed to parents to collect their demographic information and feedback related to e-book usage. The study began by asking the children to choose any available e-book application in the hand held devices. For the purpose of the study, 20 e-books were made available for children to choose from and interact with. The selection of e-books was based on users' rating (rated 4.0 and above) and the e-books were all categorized under educational purpose. The children were allowed to choose their preferred e-books as many times and as long as they liked for about 15-20 minutes. They were given opportunities to browse, select, and use the e-book application that interested them. Any conversations between the children themselves and with the researchers (as they discussed the application or asked for assistance) were used and observed to measure engagement with the application and possibly the features/software that interested them the most.

The sessions with hand held devices and touch screen laptops were recorded to unobtrusively observe their interactions with the software and with one another. Two video cameras were used to record the children's interaction with devices and their facial expressions and interactions with each other. In addition, field notes were also taken as complementary data to the observation session.

2. 1 The E-book Collection

The e-books collection used for the study was categorized into interactive e-storybooks and educational e-books. The interactive e-storybooks were e-books with text, read-aloud narration, picture, and animation features. While the educational e-books came with memory flash cards (pairing or flipping numbers/alphabets/pictures), puzzles and matching games. The most popular e-book selected was "Alphabet" which was selected by 6 children, followed by "Draw finger" and "shapes" which were selected by 3 children each, while "Mathematics Game for Children", "Twinkle Star", "Kids First ABC", "Cinderella" and "Rabbit and Turtle" were each selected by 2 children respectively. Other e-books, "Art Studio" and "Little Red Riding Hood" were only selected once.

2.2 Data Analysis

A total of 310 minutes of video observation footage were analyzed using NVivo 8. Using analytic induction procedure by Goetz and LeCompte (1984), the video footages were transcribed at one-minute intervals for emergent behaviors (verbal and non-verbal categories) and other categories of behaviors observed. The observational data were developed into an initial coding to define the emergent behaviors within three categories adopted from Roskos, Burstein and You (2012): i) Multisensory behavior was defined as sensory motor skills such as looking, touching, listening, gesturing, turning pages, pointing, dragging and swiping; ii) communication such as

asking and answering questions, and commenting; iii) emotions such as smiling, laughing, making noise, mimicking voices, eagerness, making facial and physical expressions, enjoyment and appearing distracted. The emergent behaviours were identified based on frequency counts. The emergent behaviours then were analysed according to their engagement with different: e-books, settings (independent vs shared setting), gender (female vs male), and age groups (age 4-6). Durations of completed engagement and behaviour indicators were tabulated to calculate the percentage of duration for each behaviour within an indicator occurrance. In order to validate the reliability of the data analysis, two inter-coders were used and the inter-coder agreement was at 93.6%.

Table 1: Engagement Indicators Definitions and Rules (Roskos, Burstein & You, 2012)

Category	**Definition**	**Salient Behaviour**	**Definition**	**Rule**
Multisensory behavior	using sensory motor skills (visual, auditory, haptic-Kinesthetic)	Touching	Fingers are applied to the screen	Code 'T' when holding device, touching, taping, scrolling, swiping the page dragging/moving objects/interactive elements,
		Looking	Eyes directed to the screen and/or peer's screen. Looking at the screen: ▪ waiting for loading ▪ to decide what to do for next step of the task ▪ to decide what to select ▪ to see what happened after their certain actions ▪ to see what is the peer doing ▪ to see the what is on the screen	Code 'L' if eyes and positions are oriented to the screen
		Listening	Attending to the audio and not talking: ▪ if they mimic the voice or sound they hear ▪ expressing feelings	Code 'LIS' if not talking and looking at the screen
		Gesturing	Bodily actions	Code 'G' when they shaking/moving hands when they pass a task, clapping
Communication	Verbal communication in respond to the e-books	Asking question	Asking question or answering the question in contact with observer or peers	Code 'A' if asking for help or hint from peers or observer
		Making Comments	Making comments, talking, labelling references	Code 'CM' is making comments and/or talking

Emotion	Expression to show emotion	Facial expression	Using facial gestures to express thoughts and feelings	▪ Code 'P' if smiling, happy expression ▪ Code 'N' if no expression or just gazing ▪ Code 'NEG' if appears angry, sleepy, frowning, bored, uncomfortable, shy
		Making noises	Using sounds to express thought and feelings	Code 'S' if making sounds that are not words, such as squealing and giggling

3. Findings

3.1 Demographics

A total of 18 children (9 male and 9 female) ages 4, 5 and 6 years old participated in the study. A survey questionnaire distributed to the parents added information on the children's background. A total of 15 out of 18 responses were collected from the parents, 8 of them were answered by the mothers and 7 by the fathers. The parents were between 31 and 50 years old. Nine of them were at least a bachelor degree holder with monthly household incomes of RM2, 000 - RM11, 000. The parents indicated that they read books to their children at home. 10 of them knew about e-books while 6 of them had downloaded e-books for their children, mainly in their handheld devices. Although the parents were receptive about e-book intervention for their children mainly because of its portability and interactive features, parents (10 responses) were of the opinion that the children still preferred printed books because children would give more attention during the reading process and could understand the story better.

3.2 What were the prominent indicators of children's engagement with e-books?

The observational data was developed into an initial coding to define the emergent behaviors within three categories of indicators: i) Motor skills such as looking, touching, listening, gesturing, turning pages, pointing, dragging and swiping; ii) communication such as asking and answering questions, and commenting; iii) emotions such as smiling, laughing, making noise, mimicking voices, eagerness, making facial and physical expressions, enjoyment and appearing distracted. The emergent behaviours were identified based on frequency counts.

3.2.1 Multisensory behavior

Multisensory behavior reflected sensory motor skills such as touching, looking, listening and gesturing while interacting with the e-books/apps. Figure 1 shows the frequency of different types of multisensory behaviors observed in handheld device and touch screen laptop sessions. Incidence of the touching indicator is seen to be

higher in handheld device sessions at 73% and at 63% for touch screen laptops. With handheld devices, each child had absolute control over the device and therefore greater independent interactions with e-books.

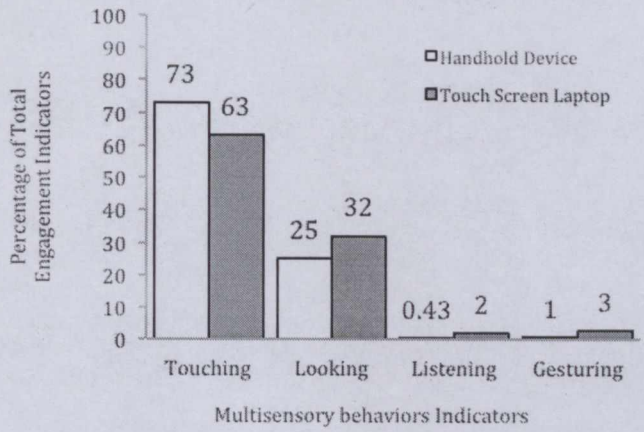

Figure 1: Incidence of Multisensory behaviour

3.2.2 Communication

Communication was represented by verbal communication in response to the e-book's engagement in touch screen devices. Figure 2 shows the frequency of two types of communication indicators shown in handheld devices and touch screen laptop sessions. A higher incidence of commenting/talking indicators (83% in independent and 95% in shared setting) was seen as the children got used to the environment and gained control of the devices. The greater incidence of commenting/talking in touch screen laptop sessions may be due to being in a sharing interaction where communication between the children was essential to deciding who should start using the device first and thus led to taking turns and competition to interact with the e-books.

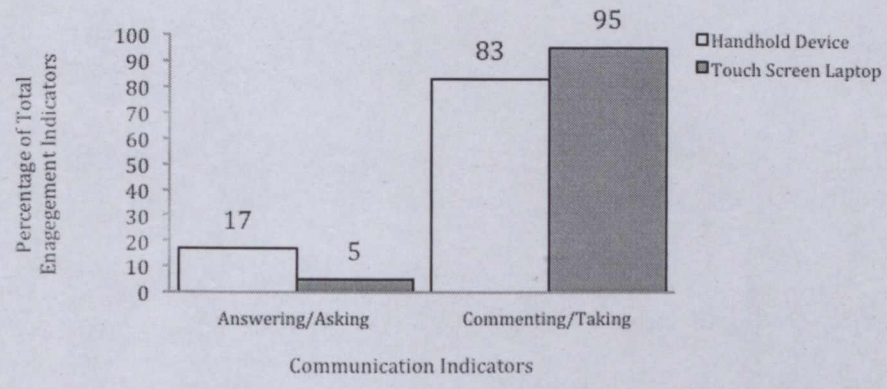

Figure 2: Incidence of Communication behavior

3.2.3 Emotion

Emotion reflected the occurrence of facial expressions and noises made during interaction with e-books in touch screen devices. Figure 3 shows the frequency of emotion indicators shown in handheld devices and touch screen laptop sessions. It appeared that the incidence of positive feeling and noise making was higher than neutral and negative behavior in both devices. Some instances of the emotion behaviours (P = Positive facial gestures; N = No expression/gazing; NEG = Negative facial gestures; S = Making sounds/noises) were as follows:

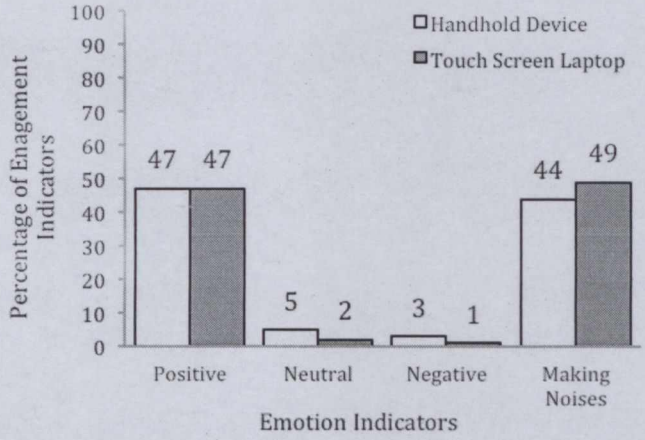

Figure 3: Incidence of Emotion Indicators

There were 10 e-books used for the study classified in two main categories, interactive e-story book and educational e-books. Three interactive storybooks featured a read along option that narrated the story to the children and games to encourage interest in reading. They were Cinderella, Rabbit and Turtle, and Little Red Riding Hood. Seven educational e-books featured a great variety of games that required skills with which to enjoy and engage the e-book. The favorites amongst the children were Shapes, Twinkle Star, Alphabet F and Art Studio

Figure 4 shows frequency of engagement indicators according to the type of selected e-books. Educational e-books had greater totals of engagement indicators, which might imply that those educational e-books should be considered the more popular type of e-book in this study. Higher sensory motor skills might rely on the fact that educational e-books included task-based activities and educational games. The key indicators in sensory motor skills for e-story books were looking and listening where children needed to listen to the narration and looked at the screen at the same time to see the interactive elements on the screen. For educational e-books, touching and looking were the more frequent indicators observed as they needed to move the objects or complete the puzzles or rearrange the whole pieces to see the final figure on the screen.

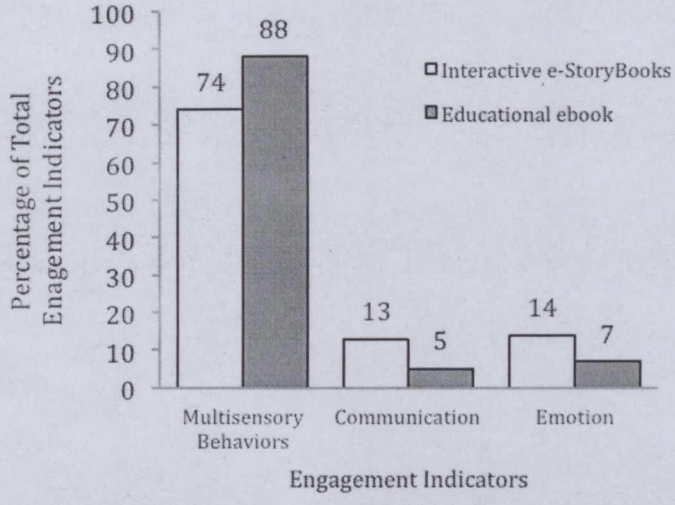

Figure 4: Incidence of Engagement Indicators based on Type of e-books

3.3 How different settings (independent vs shared setting) affected children's engagement

In an independent setting, children were given handheld devices to interact with e-books, while in a sharing setting children were given a touch screen laptop to interact with e-books.

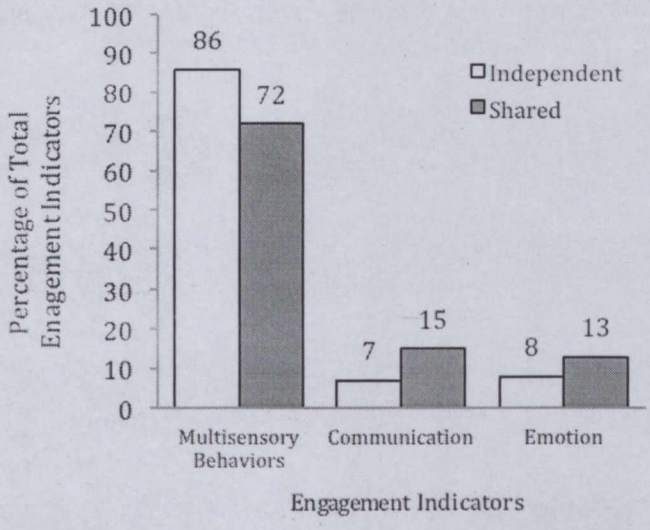

Figure 5: Incidence of Engagement Indicators based on Independent and Shared settings

A higher total of incidence of multisensory behaviors is seen in Figure 5 as compared to communication and emotion. Having greater motor skills scores in independent settings indicated that children had opportunity to take action and interact with an e-book compared to a sharing setting where they needed to wait to take turns and once in a while interacted with their peer's actions as well. Higher occurrence for communication and emotion in a sharing setting appeared to be prevalent based on

literature that children may have more verbal communication when they are involved in joint activities.

3.4 How gender (female vs male) affected children's engagement

Figure 6 shows frequency of engagement indicators based on gender. In general, both male and female had higher incidences of multisensory behavior. Girls were better at expressing their emotions when engaging with e-books while it appeared that boys expressed themselves openly with verbal communication and made noise more frequently than girls in the sense that they let their guards down when they were excited with the e-books.

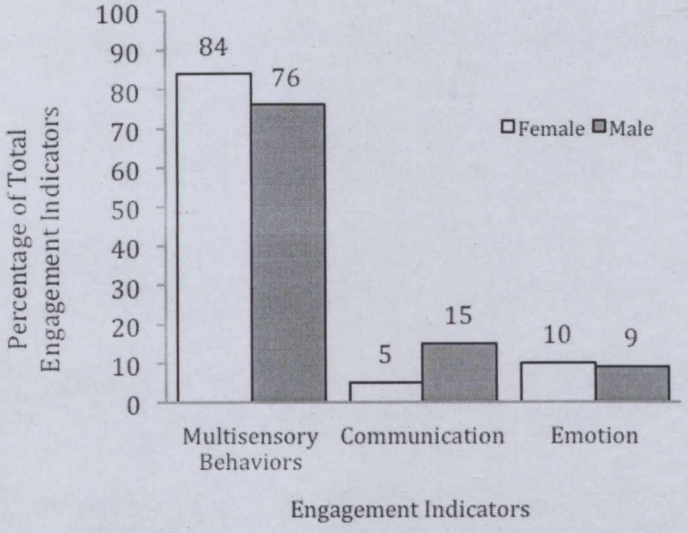

Figure 6: Incidence of Engagement Indicators based on Gender Differences

3.5 How differences between age groups (age 4, 5 and 6 years old) affected children's engagement

Figure 7 shows frequency of engagement indicators according to the ages of participants. As previously seen, multisensory behaviors had the highest total frequency. 5-year-old children had greater scores for their usage of sensory motor skills. As it appears, 4-year-old children expressed more emotion during e-book sessions while 6-year-old children interacted with each other more frequently, verbally and non-verbally.

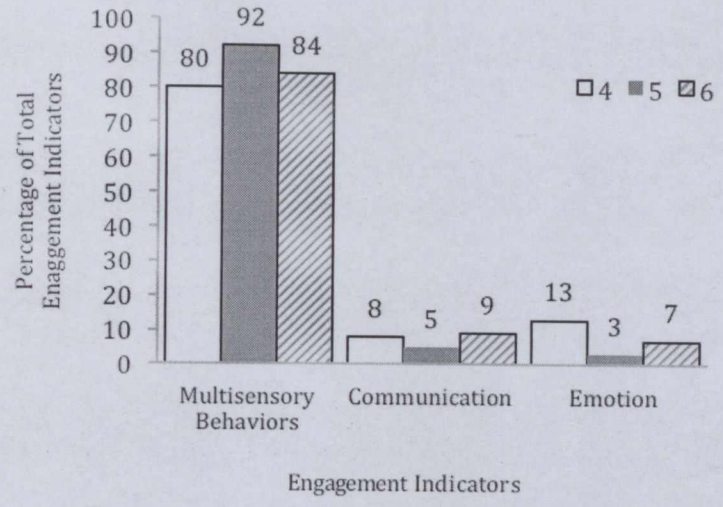

Figure 7: Incidence of Engagement Indicators Based on Age

4. Discussion and Conclusion

This research reports on young children's engagement with e-books through the landscape of three predefined indicators: i) multisensory behavior as motor skills such as looking, touching, listening and gesturing; ii) communication such as asking and answering questions, and commenting; iii) emotions such as smiling, laughing, making noise, mimicking voices, eagerness, making facial and physical expressions, enjoyment and appearing distracted.

The findings indicate the predominant engagement is in multisensory behavior that includes motor skills mainly for looking, touching, listening, gesturing (86% in shared and 74% in independent settings). In brief, looking, listening and gesturing skills appear to increase as children experience shared interaction with e-books in touch screen laptops. Communication indicators with higher incidence of commenting/talking is seen in independent (83%) and in sharing (95%) settings. The greater incidences for commenting/talking in touch screen laptops may be attributed to having a shared laptop where children need to interact and communicate with each other, take turns and sometimes even compete to interact with the e-books. It also appears that emotion indicators show higher incidence of positive feeling and making noises that could imply children in a sharing setting experience more enjoyment and excitements when engaging with e-books. The findings show educational e-books have greater total engagement indicators in multisensory behavior, with higher incidences for touching and looking that may rely on the fact that educational e-books include task-based activity and educational games. On the other hand, for e-storybooks, looking and listening are incidences in which children prefer to listen to the narrators and look the screen to see the interactive elements on the screen. The findings show that regardless of independent setting versus shared setting or differences between genders and age groups, multisensory behavior incidences in general show higher engagement indicators compared to communication and emotion indicators. Children are more engaged with haptic perception, recognizing objects through touching that stimulates children's motivation and attention because e-books provide multisensory learning experience that corroborates with Roskos, Burstein and

You (2012). This is particularly supported by interactive features in e-books that provide a new reading experience in digital format that printed books cannot afford. E-books with interactive features enable young children to interact with the storyline, sound and touch utilizing the power of tablets, thus giving the ability for children to engage more with the user interface as well as the storyline.

However interactivity features should help to enhance development of emergent literacy and not merely provide a superficial interactivity in such a way touching an image activates a simple animation (e.g. making a flower bloom). Labbo and Kuhn (2000) have reported that children spend a substantial amount of time searching for interactive features/animation as in hotspots. These hotspots, however, can be regarded as supportive of literature only if children can gain new knowledge (e.g. new vocabulary) through it. However, an excessive number of unnecessary hotspots may hinder children's engagement with the e-book content. In addition, Cahill and McGill-Franzen (2013) suggest interactive features of e-books should coordinate well with the e-books writing (e.g. character development, choice of word, amount of text), image (e.g. distinct illustrations), and narration (e.g. such as pitch, tone, accent) thus promoting engagement and advancement.

Although a particular type of interactive features that would make children engage more with e-book interaction is not a focus of this study, further study should be conducted to address this issue. This will be tied with assessing children's performance in learning using the e-book intervention. In addition, future research should embark on large observational studies using sophisticated method to closely monitor children interaction with the e-books such as using eye-tracking software. It is essential to acknowledge the limitations of this study in terms of a small sample size, limited number of apps used, and restricted focus on specific knowledge particularly related only to emergent literacy development of young children. This study however significantly provides insights on how young children engage with e-books to articulate e-book design implications as well as a general guideline to select quality e-books for home, classroom and library use to hinder disengagement. This particularly looks at features mainly related to multisensory behavior such as looking, touching, listening, gesturing; as well as, promotes communication and establish of positive emotions.

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