Are augmented reality picture books magic or real for preschool children aged five to six?

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Abstract

The aim of this study is to determine preschool children’s attitudes towards augmented reality picture books (ARPB), their story comprehension performance (SCP) and the relationships between these variables. The sample consisted of 92 five- and six-year-olds (49 boys, 43 girls). An attitude form, story comprehension test and interview form were used as data collection tools. Most of the children reported feeling “very happy” with the activity and enjoyed using the ARPB, which they found interesting and fun. The children also delivered strong story SCP. Their happiness was found to affect their SCP, while their enjoyment did not. ARPB are attractive and evocative for children, who perceive them as magic and more enjoyable than conventional books. This study demonstrates how they can be used as effective educational tools to improve preschool children’s cognition and listening skills.

Introduction

Technology is developing at a rapid pace that has dramatically affected education. With one new technology used in education, augmented reality (AR), students interact with virtual and real worlds in real time (Azuma, 1997, 2004). As the educational potential of AR technology is beginning to be researched, numerous applications are being designed. One of the most well-known AR educational applications is the MagicBook (Billinghurst, Kato, & Poupyrev, 2001). The MagicBook looks like a normal book, but AR markers are included in the interface. Users look at pictures, turn pages and read text without any external technology. With AR displays, however, users can view multimedia materials such as three-dimensional (3D) virtual models or videos and manipulate virtual objects using real physical markers and natural motions (Billinghurst et al., 2001). This interaction is an interesting way to bridge real and virtual worlds. Physical objects provide natural interactions compared with traditional computer input devices (Bujak et al., 2013). Further, the appearance of 3D objects on the pages creates a magical feeling that captures and keeps the attention of students during learning. The creation of these books is cost-effective and simple, requiring only proper AR software and a webcam-enabled PC.
configuration. Thus, several researchers have developed AR picture books (ARPB) (Behzadan & Kamat, 2013; Cheng & Tsai, 2014, 2016; Kao & Shih, 2013; McKenzie & Darnell, 2003). The current study applies the term ARPB to represent story books created with AR technology (Cheng & Tsai, 2014, 2016). ARPB resemble printed books, except that computer-generated graphics or information are superimposed on the pages, thus enriching users’ learning experiences beyond simple electronic book reading (Cheng & Tsai, 2014; Sellen & Harper, 2003). They provide attractive learning experiences (Dünser & Hornecker, 2007) and unique educational benefits via new instructional methods (McKenzie & Darnell, 2003). In the context of preschool learning, picture book reading has been widely recognized as beneficial for language development, cognitive engagement and artistic thinking (Bus, van IJzendoorn, & Pellegrini, 1995; Cheng & Tsai, 2014; Elia, van Den Heuvel-Panhuizen, & Georgiou, 2010; Hsiao, 2010). How to support and facilitate children’s picture book reading is thus worthy of further attention.

Although there are lots of benefit of digital technologies for young children, there may be some negative effects on them. These may be harmful content, consumer-related risks, privacy-related

Practitioner Notes
What is already known about this topic
• Augmented reality (AR) technology is relatively new, and its educational potential is beginning to be researched.
• AR picture books (ARPB) capture and keep the attention of students in the learning.
• Limited research has been conducted about the different emotional aspects affected while preschool children are using AR applications.
• Despite the known educational potentials of AR technology, how students learn from this content is still not well understood.

What this paper adds
• Research studies on preschool education is particularly limited, so this study can fill a gap in the literature.
• ARPB reading activities are beneficial for children, and revealing the potential of their applications in preschool education will also contribute to the related literature.
• Investigating children’s attitudes and story comprehension performance is always valuable when assessing the integration of new technologies.
• Implementing in preschool settings, incorporating reading, studying a large sample size and investigating important variables for education are all factors that will contribute to further studies in this area.

Implications for practice and/or policy
• ARPB can be used an educational tool to improve preschool children’s cognition and listening skills.
• Using ARPB, children’s transitions to reading can be shaped as learning with fun.
• Parents and teachers can collaborate to increase children’s access to ARPB at home. In addition, they should moderate the usage of them with young children in terms of health and safety, emotional, intellectual, social and moral and other factors, etc.

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risks (OECD, 2015) and health-related risks such as physically, emotionally, socially, intellectually and morally (Bremer, 2005). In addition, excessive use of Internet may cause children to be poor academic performance and to be unhealthy due to reducing time of sleeping, studying and activity (OECD, 2015; Park, Kang, & Kim, 2014). Therefore, when taking into consideration these risks of digital technology, it is important that spending too much time using ARPB may cause some similar risks for young children.

**Background of the study: children’s attitudes towards ARPB**

This research first aims to examine children’s attitudes towards ARPB, which were assessed by investigating their enjoyment and happiness. Happiness and enjoyment are similar emotions with important differences. Enjoyment may lead to the ultimate destination, happiness. Enjoyment is firmly rooted in the process of action and is therefore intimately related to and inseparable from time. It is unstable by nature. Happiness is more robust and comprehensive than enjoyment, reflecting the general feeling of a person. Enjoyment is temporary, whereas happiness is characterized by durability and inner self-satisfaction (Bruni & Porta, 2007; Shanmugapriya & Gnanaselvi, 2015). While enjoyment accompanies an activity, happiness emerges through success in doing activities initially aimed for (Brown & Juhlin, 2015).

When these concepts are examined in terms of media, enjoyment can be defined as “the degree to which the activity of using the media is perceived to be personally enjoyable” or pleasing (Giannakos, 2013). Happiness, conversely, is “the degree to which a person feels good about using media”. Enjoyment can be considered as an aid to motivation, and according to entertainment theory, media users actively control their enjoyment experiences (Vorderer, Klimmt, & Ritterfeld, 2004). Similarly, when the end-goal of a learning process is interrupted (Mandler, 1984 cited in Kay, 2008) emotions such as happiness or dissatisfaction may be triggered, creating a positive or negative experience. In our study, we examine both children’s enjoyment and happiness. These variables have been identified in the literature as having high importance in determining general attitude (Bourgonjon, Valcke, Soetaert, & Schellens, 2010; Giannakos, 2013). Also, enjoyment and happiness are related to intrinsic motivation, i.e., a drive to complete an action or activity, in our case—reading activity. Motivation is a prerequisite for student engagement in learning. When students are intrinsically motivated, they are more competent and engaged in their learning (Blumenfeld, Kempler, & Krajcik, 2006; Deci & Ryan, 2008; Saeed & Zyngier, 2012). Moreover, children’s literacy learning and engagement are directly related to their motivation and attitudes (Mata, 2011; Wigfield, 1997). Also, reading activities which are designed for children are important for their motivational processes and reading engagement (Baroody & Diamond, 2013; Guthrie, McRae, & Klauda, 2007; Wigfield, Guthrie, Tonks, & Perencevich, 2004). Therefore, the ARPB, which is an interesting development from traditional reading activity, was specifically designed for children and their enjoyment and happiness were examined.

**Children’s enjoyment**

Enjoyment is closely related to learning. It improves students’ intrinsic motivation and interest in the material. It also supports deep involvement and complete immersion in an activity, promoting flow experiences (Pekrun, 2014). Enjoyment can be regarded as the degree to which using technology is felt to be personally enjoyable. It is related to the children’s perception of how much fun they are having in an activity (Mitchell, Chen, & Macredie, 2005). Researchers have demonstrated that enjoyment plays an important role in users’ attitudes to computer technologies and technology acceptance (Atkinson & Kydd, 1997; Davis, Bagozzi, & Warshaw, 1989; Khong & Song, 2003; Mitchell et al., 2005; Venkatesh, 2000). Also, there is a correlation between enjoyment and ease of use and enjoyment is significant in explaining intention to use applications (Balog & Pribeanu, 2010; Hsu & Lin, 2008; Venkatesh, Speier, & Morris, 2002; Yi & Hwang,
When AR is evaluated within this context, educational AR applications often prove enjoyable for children, who perceive them as magic. McKenzie and Darnell (2003) and Wang, He, and Dou (2013) found that children have positive attitudes towards AR applications, finding them easier to use and more inspirational than traditional activities. Moreover, children enjoy story activities that include 3D graphics and interactive sound (Fridin, 2014; Zhou, Cheok, & Pan, 2004). When AR is integrated with picture books, it is attractive and interesting to its users. In recent years, some educational ARPB have been developed, and users have demonstrated positive attitudes towards them (Billinghurst et al., 2001; Clark & Dünser, 2012). Because enjoyment is a main indicator for positive attitudes toward technology, it was a factor examined in this study.

Children’s happiness
Increased attention has been given to the study of positive emotions, which are important to individual growth and development (Gabriele, 2008; Seligman, 2004). Some researchers have studied the effects of emotions on cognitive processing (Kay & Loverock, 2008). Improving the emotional states of students during instruction can lead to improved learning experiences (Reilly & Kort, 2004). Many studies have pointed out how emotions are important to learning (Chen & Sun, 2012; Isen, 1990; Izard, Kagan, & Zajonc, 1984; Kort, Reilly, & Picard, 2001; Pekrun, Goetz, Titz, & Perry, 2002; Piaget, 1989; Vygotsky, 1994). For example, positive feelings facilitate active information recall (Isen, 1990). During the learning process, children’s emotions affect their motivation because learning is both a cognitive and emotional experience. If educational technologies provide positive emotional support, they are more likely to lead to positive learning experiences and to improve learning outcomes (Antonio, Martin, & Stagg, 2012; Giannakos, 2013). While negative emotions may slow down students’ ability to learn (Kay, 2008), positive experiences enhance their learning growth and development. Positive emotions lead to better integration with others and the environment and may build confidence and self-efficacy (Bandura, 1982; Fredrickson, Tugade, Waugh, & Larkin, 2003; Gabriele, 2008; Kay, 2008). The emotion of learners contributes to the learning environment and plays a role in the learning process (Kay, 2008). The literature has also identified a positive correlation between computer knowledge and positive emotion (Hay, 2008; Kay, 2008). These effects of emotion on learning are mediated through children’s motivation to learn, teaching strategies, cognitive resources and self-regulation (Pekrun, 1992; Pekrun et al., 2002). However, limited research has been conducted about the emotional aspects affected when learners use AR applications. Therefore, this study focuses on preschool children’s happiness while using ARPB as key predictors of emotional and social competence (Denham, Mitchell-Copeland, Strandberg, Auerbach, & Blair, 1997).

Children’s story comprehension performance
Second, this study aims to examine children’s story comprehension performance (SCP). At the preschool level, ARPB reading is beneficial for children’s language development and cognitive engagement (Elia et al., 2010). Specifically, ARPB may enhance children’s comprehension of content through interaction with audio-visual materials (Dias, 2009). ARPB offer an opportunity to enrich users’ learning experiences beyond printed books. The effects of ARPB applications improve students’ cognitive attainment and have a positive influence on overall learning effectiveness (Ibáñez, Di Serio, Villarán, & Kloos, 2014; Martín-Gutiérrez et al., 2010; Shelton & Stevens, 2004). As stated above, physical actions aid in the recall of information. Children who act out a story using physical props while reading sentences are better at recalling facts and relationships about a story than those who do not (Bujak et al., 2013; Glenberg, Brown & Levin, 2007). Moreover, AR technology creates embodied representations. Students demonstrate better memory capacity for physically interactive content compared with noninteractive content (Hornecker & Dünser, 2009). Despite the known educational potentials of AR technology, how students learn from this content is still not well understood and the number of dedicated studies

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is insufficient (Cheng & Tsai, 2014). Therefore, this study focuses on students’ comprehension when using ARPB.

The ARPB

For the purpose of this study, 10 picture books were developed with AR technology. The main purpose of these books was to improve the SCP, enjoyment and positive attitudes of preschool children. All stories had an educational theme and animated pages, which are expected with these types of books. Each child could take a book in hand, read it and interact with it using AR technology. When they looked on the computer screen, they saw 3D animations of stories (scan quick response (QR) code for video). The stories’ titles and main themes appear in Table 1; picture examples are in Figure 1.

<table>
<thead>
<tr>
<th>Title</th>
<th>Main theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generous Sultan</td>
<td>Generosity</td>
</tr>
<tr>
<td>Equal Shares</td>
<td>Sharing</td>
</tr>
<tr>
<td>Kaloghlan (a Turkish fictional character)</td>
<td>Clear thinking</td>
</tr>
<tr>
<td>Cheerful Butterfly</td>
<td>Collaboration</td>
</tr>
<tr>
<td>Brown Bear</td>
<td>Disadvantages of ulterior motives</td>
</tr>
<tr>
<td>Colorful Latches</td>
<td>Helpfulness</td>
</tr>
<tr>
<td>Two Opposite Dogs</td>
<td>Beautiful thoughts</td>
</tr>
<tr>
<td>Kaa is Learning Listening</td>
<td>Respect</td>
</tr>
<tr>
<td>Ceren’s Diary</td>
<td>Sharing of emotions</td>
</tr>
<tr>
<td>Sütbeyaz’s Birthday</td>
<td>Friendship</td>
</tr>
</tbody>
</table>

Table 1: Selected stories and themes

Purpose

Early reading skills for preschool students are closely related to their future reading competencies (Mioduser, Tur-Kaspa & Leitner, 2000; Storch & Whitehurst, 2002). However, many children not ready to learn in early childhood classrooms because they are lack of some skill such as cognitive and social (Bulotsky-Shearer & Fantuzzo, 2011; Denham, 2006; Rimm-Kaufman, Pianta, & Cox, 2000; Thompson & Raikes, 2007). For example, they cannot follow teacher’s instruction, not focus on a work or not sit still (McClelland, Morrison, & Holmes, 2000; Rimm-Kaufman et al, 2000). Because reading is a complex cognitive process (Shaul & Nevo, 2015), there is a risk of early reading difficulties (Lee, Grigg, & Donahue, 2007), especially with encoding and retrieving information stored in long-term memory (Felton, 1993). Training in early reading skills can improve reading performance and prevent learning difficulties before children face such problems and they take root (Kirby, Desrochers, Roth, & Lai, 2008; Shaul & Nevo, 2015). Computers are ideal tools for this training due to their high quality aural and visual capabilities (Mioduser et al., 2000; Plowman & Stephen, 2005). As well as computers, other new technologies offer high potential for edutainment in developing early reading skills. Studies in the literature have revealed how children’s interest in or enjoyment of reading is predictive of their early reading skills (Burgess, Hecht, & Lonigan, 2005; Johnson, Martin, Brooks-Gunn, & Petrill, 2008). Moreover, some researchers have recommended that interest and engagement in literacy activities are crucial factors in early reading skills’ development (Bracken & Fischel, 2008; Gambrell & Gillis, 2007). When children take an interest and engage during reading activity, they have more opportunities to practice early reading skills (Baroody & Diamond, 2014). AR capitalizes on that enjoyment by creating a magical feeling for children and providing attractive learning experiences. Although the real world is 3D, phenomena, events and processes are generally only
explained through 2D media. AR can transform 2D pictures into 3D virtual objects and animations, offering an attractive and fun way to learn. AR attracts the attention of children, who perceive it as edutainment instead of pure learning. However, AR technology is still in the initial phases of research, and a solid visualization based on user needs and expectations has yet to be developed. Although some studies on the subject of technological support in preschool education have been conducted, AR research on preschool education is particularly limited. Therefore, the aim of this study is to begin to fill that gap in the literature. When Bacca, Baldiris, Fabregat, Graf, and Kinshuk (2014) reviewed educational AR applications, they found that most studies had been carried out in higher education settings. However, it is important that target groups such as children in preschool should also be explored with regard to the potential use of AR in the future. ARPB reading activities are beneficial for children, and revealing their potential in preschool education will further contribute to the literature. In addition, investigating children’s attitudes and SCP is always valuable when assessing the integration of new technologies. Briefly, implementation in preschool settings, incorporating reading, studying a large sample size and investigating important variables for education are all factors that will contribute to studies in this area. Drawing from this assessment, the current study examines the following research questions:

1. What are children’s attitudes towards ARPB?
   a. What is their level of happiness?
   b. What is their level of enjoyment?
   c. What are their views regarding ARPB after using them?
2. What are the children’s levels of SCP after using ARPB?
3. Are there correlations between the variables of happiness, enjoyment and SCP?
Method

Research design
Explanatory design was applied in this study. Descriptive and correlational methods were used to determine the children’s attitudes and SCP as well as revealing correlations between those variables. To explain the quantitative results, interviews were conducted. In this study, the sample consisted of 92 preschool children aged five to six (49 boys, 43 girls). In some countries, school starting age for preschool can be different. In Turkey, 5- and 6-year-olds are typically in preschool, while 7-year-olds could be in first grade in elementary school. In our study, 16 children were 6-years-old and 76 were aged five. Convenience sampling was applied because the preschools were selected according to accessibility and willingness to participate.

Permission to carry out research with young children was received from Ataturk University Research Ethics Committee. The research process consisted of five steps: analysis, design, development, implementation and evaluation. During analysis, story books were examined, and after consulting 10 preschool teachers and 3 instructional design experts, 10 stories with educational themes were selected (see Table 1). Interviews were conducted regarding animations with instructional design experts, who suggested 3D cartoon characters. AR software was analyzed, and the Metaio Creator was selected. The aim of the activity was to provide a sense of animating the story pages. To accomplish this aim, storyboards and 3D animations were designed in the second step. The book pages were designed as markers and had the same design as the initial animated scene. During the development process, pages were created with Photoshop CS5, and 3D animations were designed with Muvizu. In the implementation process, a pilot study was conducted with 10 children and 10 teachers to identify challenges and fix problems. Next, ARPB activities were implemented. Each child took a book in hand, read it and interacted with it using AR technology (see Figure 2). The books transformed on the computer screen into 3D animations. All implementations were conducted in preschools under teacher observation and classroom management. Children’s attitudes and SCP were evaluated in the final phase.

Data collection tools
To measure attitude, we developed a form according to Giannakos (2013), who administered a survey assessing enjoyment, intention to use, and happiness. For the current study, only the factors of enjoyment and happiness were measured. For happiness, a single visual analogue scale ranging from very happy (5) to very unhappy (1) was offered to children to describe how they felt about studying with the ARPB (see Figure 3). They selected their feelings using pictorial representations, which is widely preferred to traditional open-ended or closed-question formats for young children specifically (Giannakos, 2013; Read & MacFarlane, 2006). Using only one item to measure the factor of happiness does present certain limitations. However, single-item self-
reported measures embedded in a questionnaire are commonly used to assess happiness. Many studies utilizing such measures have found them to be both reliable and valid (Harry, 1976; Klassen, 2008; Swinyard, Kau, & Phua, 2001).

To assess enjoyment, a 3-point ordinal scale was used (see Table 2). Giannakos (2013) and Venkatesh et al. (2002) used the same items in their studies to determine the degree to which ARPB were perceived to be personally enjoyable. Cronbach’s alpha for the attitude form was 0.89. For SCP, we adapted a story comprehension test (SCT) from a third grade school book consisting of seven questions regarding the story’s time, place, main characters, other characters, initiating event, consequences and main theme. Finally, we developed the interview form to explain the quantitative findings. All data collection tools and the research process were controlled by three experts in terms of sampling, aim and scope.

Children’s emotional states may be affected by environmental factors. Therefore, some precautions were taken in the current study to ensure validity and reliability of data. The environment was designed to make the children feel confident and comfortable. Measures were taken to ensure that their attitudes were not influenced by their teacher, who did not participate in the activity but only helped with technical problems. Each child engaged with the ARPB individually. At the end of the activity, data was collected by reading questions to the children. We asked each question in turn, the child answered it, and then we filled in the questionnaire accordingly. Questions were repeated if the child did not understand, and children were encouraged to speak freely to increase understanding of their perspectives.

Data analyses
In this study, data were collected after implementation. First, missing data analyses were conducted. While descriptive and correlational analyses were used for quantitative data, content analyses were applied to the qualitative data. To determine correlations, Spearman’s rho was used because the data did not have normal distribution. Codes and categories for qualitative data were created according to the children’s expressions.

Findings
Children’s attitude
In this study, children’s attitudes were examined in terms of happiness and enjoyment.
Children’s happiness
In this study, children’s happiness when using ARPB were determined by a 5-point Likert scale (5 = very happy, 1 = very unhappy). Most of them reported feeling very happy ($M = 4.41$, $SD = .951$). Regarding gender, girls were happier overall ($M = 4.51$, $SD = .668$) than boys ($M = 4.32$, $SD = 1.143$), but more boys were very happy than girls. While all girls were generally very happy or happy, some boys reported feeling very unhappy. Detailed findings are illustrated in Figure 4.

Children’s enjoyment
In this study, children’s enjoyment of the ARPB was determined by an ordinal scale (“I agree,” “Neutral,” “Disagree”). Results showed that all children enjoyed the activity ($M = 2.82$, $SD = .553$). They found the ARPB interesting ($M = 2.85$, $SD = .443$) and fun ($M = 2.96$, $SD = .253$) and stated that “I like using it” ($M = 2.96$, $SD = .253$) and “I enjoy aspects of my studying that require me to use ARPB” ($M = 2.84$, $SD = .519$). Enjoyment levels and their mean and standard deviation values are illustrated in Figure 5.

Children’s views
To explain the quantitative findings, the qualitative data were examined using content analysis. Therefore, the reported language is not the children’s verbatim expressions. All codes and categories are presented in Table 3.

Children’s SCP
In this study, children’s SCP was measured and found to be strong ($M = 68.01$, $SD = 22.450$). Although the mean score was not high, overall findings were positive. Because the SCT had seven items with score ranges, the standard deviation was increased and the findings were evaluated accordingly. While 51 children scored above the average (55.4%), 41 children scored below
The students mostly remembered their story’s consequence, time and place, but they struggled to remember its main theme (see Figure 6).

**Correlations between variables**

In this study, correlations between all variables were determined. Findings showed that children’s happiness influenced SCP, while enjoyment did not (see Table 4).

Table 3: Qualitative findings and their frequencies

<table>
<thead>
<tr>
<th>Reasons</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is <strong>interesting</strong> because of</td>
<td></td>
</tr>
<tr>
<td>the story’s animations</td>
<td>10</td>
</tr>
<tr>
<td>story’s characters</td>
<td>6</td>
</tr>
<tr>
<td>story’s objects</td>
<td>5</td>
</tr>
<tr>
<td>story’s sounds</td>
<td>3</td>
</tr>
<tr>
<td>It is <strong>funny</strong> because</td>
<td></td>
</tr>
<tr>
<td>the pages of the story animate</td>
<td>9</td>
</tr>
<tr>
<td>the book speaks to me</td>
<td>5</td>
</tr>
<tr>
<td>I feel the book senses my presence</td>
<td>3</td>
</tr>
<tr>
<td>the context of the story is</td>
<td>2</td>
</tr>
<tr>
<td>funny</td>
<td></td>
</tr>
<tr>
<td>I <strong>like</strong> it because</td>
<td></td>
</tr>
<tr>
<td>it is magical</td>
<td>6</td>
</tr>
<tr>
<td>objects and characters of the</td>
<td>5</td>
</tr>
<tr>
<td>story are good</td>
<td></td>
</tr>
<tr>
<td>the pages of the story animate</td>
<td>5</td>
</tr>
<tr>
<td>the book and animations are</td>
<td>4</td>
</tr>
<tr>
<td>colorful and good</td>
<td></td>
</tr>
<tr>
<td>I <strong>want to use</strong> it because</td>
<td></td>
</tr>
<tr>
<td>it is funny and exciting</td>
<td>10</td>
</tr>
<tr>
<td>I love it</td>
<td>9</td>
</tr>
<tr>
<td>I perceive the animations like</td>
<td>5</td>
</tr>
<tr>
<td>cartoon films</td>
<td></td>
</tr>
<tr>
<td>I’m <strong>very happy</strong> using it</td>
<td></td>
</tr>
<tr>
<td>when I see the animations appear</td>
<td>8</td>
</tr>
<tr>
<td>like magic</td>
<td></td>
</tr>
<tr>
<td>when I hear the sounds</td>
<td>5</td>
</tr>
<tr>
<td>because I have never seen</td>
<td>4</td>
</tr>
<tr>
<td>anything like this book before</td>
<td></td>
</tr>
<tr>
<td>I have a <strong>positive attitude</strong></td>
<td></td>
</tr>
<tr>
<td>because</td>
<td></td>
</tr>
<tr>
<td>I believe it is a magic book</td>
<td>12</td>
</tr>
<tr>
<td>the book speaks to me</td>
<td>9</td>
</tr>
<tr>
<td>the characters are moving</td>
<td>8</td>
</tr>
<tr>
<td>the book and animations are</td>
<td>6</td>
</tr>
<tr>
<td>colorful</td>
<td></td>
</tr>
<tr>
<td>the book is good in every</td>
<td>5</td>
</tr>
<tr>
<td>respect</td>
<td></td>
</tr>
<tr>
<td>something appears when I turn</td>
<td>4</td>
</tr>
<tr>
<td>the pages</td>
<td></td>
</tr>
</tbody>
</table>
Discussion

In this study, children’s SCP and attitudes towards ARPB were examined. Results revealed positive attitudes, which is similar to the literature (Billinghurst et al., 2001; Clark & Dünser, 2012; McKenzie & Darnell, 2003). This finding may be explained because of being a new technology and perceived as having a novelty effect. However, users can face technical and usability problems when using a new technology. This could be considered a negative effect. But in our case, because of the technical support provided by the teachers, the children did not face any problem. Therefore, novelty effect and technical support are considered as positive effects for children. Also, raising a sense of magic in children is important (Billinghurst et al., 2001). Qualitative data provided acceptable clues to explain this result. One of the most important clues explaining the children’s positivity was that they perceived these books to be magic. Qualitative data indicated that the children thought these books had the ability to talk, that the characters were alive and that different objects were observed on each page of the book.

Another result obtained in this study was that children were happy while using these books. Although 7% of the boys reported feeling not happy or neutral, the girls were totally happy according to the verified data. This result may be explained by boys’ preferences for interaction and action (Tsai, Hong, & Ho, 2009). In this activity, they were physically inactive. According to Tepper and Cassidy (1999), gender differences affect preschool children’s preferences for particular protagonists in picture books. For example, if the main character in a story was a boy, the boys were considerably more active and vice versa. In our study, boys may select a story in which a girl is the main character or vice versa. So, this may affect their happiness. Obregón (2014) found that while boys liked stories about superheroes, villains, monsters, animals and dinosaurs, girls preferred family life, domestic activities and royalty themes. In the light of this information, our stories and their themes were more likely to interest girls, and selected stories may have affected the boys’ happiness. Children’s literacy interest levels may also influence happiness. In previous studies, girls showed significantly higher literacy interest than boys (Alexander, Johnson, Leibham, & Kelley, 2008; Meece, Glienke, & Burg, 2006), further explaining the higher

Figure 6: Children’s percentages regarding SCT items

Table 4: Spearman’s rho correlation coefficient between variables

<table>
<thead>
<tr>
<th></th>
<th>Happiness</th>
<th>Enjoyment</th>
<th>SCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment</td>
<td>.084</td>
<td>1</td>
<td></td>
</tr>
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<td>SCP</td>
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**p < 0.01
levels of happiness of girls in the current study. The qualitative data revealed that the animations were perceived as magic and made the children happy. Hearing voices and encountering such an activity for the first time were other important factors related to their happiness. The enjoyment levels of the children were determined to be high because they found the books attractive and entertaining. This finding can be explained by the books’ 3D graphics and sounds (Fridin, 2014; Zhou et al., 2004). Similar results were obtained in the qualitative data analysis. The children described the ARPB as attractive because of their animations and 3D characters. One entertainment factor is the ability of the books to talk with the children, who experience a sense of presence with the books and appreciate their funny contexts. Similar reasons led the children to express their desire to use these applications again in the future. Clearly, all of these factors increased the children’s enjoyment.

Children’s SCP was also determined to be high. Using ARPB increased their chances of remembering a story’s consequences, time and place, yet they struggled to remember its main theme. The high SCP scores with regard to the story’s consequence, time and place are likely related to the attractive AR presentation, which is reinforced with audio and visual materials. Emphasizing a story’s time and place with 3D visuals and audio in ARPB would be highly effective at further increasing SCP. In line with the literature, the ARPB enhanced children’s SCP via interaction (Dias, 2009; Glenberg et al., 2007; Hornecker & Dünser, 2009), enriching learning experiences more than printed counterparts alone. ARPB may also improve students’ cognitive skills and learning effectiveness via their embodied representations, since students demonstrate better memory performance with physically interactive story content (Hornecker & Dünser, 2009; Ibáñez et al., 2014; Shelton & Stevens, 2004). As far as AR in education, students’ understanding, learning and retention were found to be better with AR applications when compared with only listening to, reading or viewing content (Wojciechowski & Cellary, 2013; Yang, 2012). In literature, children who act out a story using physical props while reading perform better when recalling facts and relationships about a story (Bujak et al., 2013; Glenberg et al., 2007). This characteristic of AR supports the learning-by-doing paradigm and situated learning theory (Schank, Berman, & Macperson, 1999). In the current study, main theme cognition was low, though the children should have been able to understand each story completely. This finding may be an outcome of student participation as viewers of 3D animations and listeners to audio, rather than as creators of AR stories. The fun multimedia aspects of the ARPB may have prompted children to focus on the visual components instead of the theme.

Finally, a positive and meaningful relationship between the children’s learning with ARPB and happiness was observed; conversely, no evidence emerged indicating a relationship between SCP and enjoyment. During the learning process, children’s happiness can affect motivation and SCP, as learning is a cognitive and emotional experience. If educational technologies transfer positive emotions to children, they can lead to positive learning experiences (Giannakos, 2013). Although contrary to the findings of the current study, Giannakos (2013) found that while enjoyment has a positive effect on children’s SCP, happiness has an insignificant effect. Happiness and enjoyment are similar but with important differences. While enjoyment is firmly rooted in the process of action, happiness is more robust and comprehensive, reflecting the general feeling of a person. Because happiness is characterized by durability and inner self-satisfaction (Bruni & Porta, 2007; Shanmugapriya & Gnaneselvi, 2015), there may be a correlation between SCP and happiness. No correlation emerged in the current study between enjoyment and SCP, which may be due to enjoyment’s characteristic as a temporary feeling (Bruni & Porta, 2007; Shanmugapriya & Gnaneselvi, 2015). The insignificant relationship between enjoyment and SCP could be tied to the fact that the children were having too much fun while reading. When we examine our
correlation values, we see a negative relationship: though enjoyment increased, SCP decreased. Therefore, it may be that as children focus on their enjoyment of an ARPB and its funny features, they are actually distracted from learning. Giannakos (2013) stated enjoyment might have an influence on students’ learning performance. Indeed, our result can be interpret as unexpected. Therefore, relationship between enjoyment and learning performance should be explore further.

Conclusions and recommendations
In this study, preschool children’s SCP and attitudes towards ARPB were analyzed to examine the correlation between these variables. The large sample size and the integration of AR technology into preschool education are two strengths of the research, though the study was limited to a single reading of a single story for each child. The study was also limited by the validity and reliability of the children’s responses. Results showed that the children were satisfied with the ARPB, were happy while using them, and scored well on their SCP. Although ARPB positively affect children, they can cause some negative effects in the same way as other digital technologies. As we know, computers may be hazardous for children’s health in many ways, eg: physically (musculoskeletal, obesity, visual strain, etc), emotionally and socially (social isolation, lack of self-motivation, commercial exploitation, etc), intellectually (lack of creativity, impoverished literacy skills, stunted imaginations, etc) and morally (online violence, devoid of ethical and moral context etc) (Bremer, 2005). Because ARPB can be used with computers, all these issues require to be taken into account. In particular, spending too much time using ARPB may cause children to be less physically active and to develop visual disorders and musculoskeletal problems. Also, sociocultural and well-being problems can occur because people’s lives become dominated by virtual, screen based experiences rather than first hand experiences. Children’s health is endangered as the technologies are addictive and interactions with family are reduced (Plowman, McPake & Stephen, 2010). In accordance with these findings, we make the following recommendations:

• ARPB can be used as educational tools to improve preschool children’s cognition and listening skills.

• Using ARPB, children’s transitions to reading can be shaped as learning with fun.

• Parents and teachers can collaborate to increase children’s access to ARPB at home.

• Including a 3D pedagogical agent in AR applications can offer design guidance and trigger children to initiate daily activities such as preparing for bed, playing, brushing their teeth or eating.

• AR flash cards including 3D objects and animations can be designed for activities in language, math and science education, increasing children’s learning enjoyment.

• Teachers and parents should not allow children to spend too much time using ARPB in view of the potential risk of physical, social, health and ethical problems.

• Relationship between enjoyment and learning performance should be explore in future studies.

Statements on open data, ethics and conflict of interest
Detailed information about data collection process described in method section. Also, we can share our data (SPSS sav and output files) with readers who need this data set via email.

This study was supported by Ataturk University Scientific Research Project (SRP/2012:503). The implementations were conducted at 10 different preschools in Erzurum/Turkey. Before implementations, necessary permissions were taken from preschool’s teachers. All children in our study were voluntary. Implementations were performed at their reading activity lessons. Teachers and researchers helped them during activity. Children’s faces and names didn’t use anywhere for this study.
There is no conflict of interest between researchers. Because all of them were collected data and conducted process of the study together. Authors’ name order of the study were done according to their contributions.

References


