

Young Children's Perceptions of the use of digital interactive book in early childhood education

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Abstract: *The preference of preschool children on interactive traditional paper books has long been proved. More novel than the traditional interactive books, also called movable, mechanical or novelty books are the Augmented Reality books, which have a place in the book market for more than a decade now. In Greece AR books appeared in 2016 and they are considered young but very promising for educating and amusing children. The requirements for using AR books cannot yet meet those of mobile devices that most Greek readers have, thus their audience is still limited. Our approach to interactive books (traditional or AR) focus on the use and on learning and fun opportunities they have to offer to preschool children.*

Key Word: *Augmented Reality books; paper interactive books; movable books; mechanical books; early childhood education.*

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I. Introduction

Diabetes Literacy is considered the result of culture and teaching, which in a particular culture is constantly redefined through technological change [1]. Image-text relationships contribute to the formal representation of meaning of new literacies in multiple modalities, which also include music, sound effects, and digital features such as windows and hyperlinks. This multimodal communication of meaning is a key dimension of the constant re-conception of literacy that has led to the structuring of multimodalities [2, 3]. While Kress and Leeuwen [4] support the role of language for the expression of ideas, feelings, values along with other modes, Baldry and Thibault [5] claim that a multimodal text may contain other modalities for meaning production, that are not necessarily linguistic.

The term interactive represents books that are made of paper or other materials and allow children to perform certain actions and play with them. These books belong either to the illustrated book genre (books with images) or to the picture books genre (image books), in which images have greater functionality to produce meaning [6].

However, Labbo [7] supports that the "new literacy", often, is associated with "digital literacy". The use of e-books and many reading applications along with the use of ebook-readers and tablets have already changed the reading environment, which is called digital [8]. The widespread use of these media confirms the transition to a hybrid literacy stage and the need for education and gradual adaptation of children to the new reading culture.

Many current studies [9] focus on the use of new media and on how they will help students to improve educational productivity, i.e., to enhance reading comprehension and even increase their motivation and commitment. Grimshaw and colleagues [10], Higgins and Hess [11], Korat and Shamir [12] investigated the effectiveness of e-books in relation to children's literacy. Zucker, Moody and McKenna [13] in a meta-analysis of the above publications concluded that technology can play a supportive role in children's literacy in the following areas: vocabulary acquisition, accessibility to texts, play, peer collaboration, restraint knowledge and reading comprehension. Hyman, Moser and Segala [14] claim that modern book applications aim to enhance the user experience, as they have characteristics, such as embedded videos, crossword puzzles, quizzes, and other sources.

Thus, next to the traditional interactive books, a new era of interactive books, with different properties are now available: the AR books. Still hybrid: -half material, half application, AR books depend on children in order to be used, activated, handled and to become toy-books.

According to Appleyard [15] preschool readers have two roles. They are both listeners and players. In the same line of research Kanatsuli [16] states that books as objects call upon a player while Yannicopoulou [17] supports that interactive book, such as lift-the-flap or split-paged and many other can become "plausible excuse for playful reading, which asks players to read and readers to play".

Gibson [18] much earlier than Appleyard [15] defines books as a medium of knowledge which has second handed knowledge. Newborn children explore the world around them by using their immediate senses. They look, hear, smell, taste, and touch. Children, in addition to being directly aware of the world, are also obliged to be aware of the world. Their parents “show them things, say things to them and give them models and images of things, and finally rules and shortcuts to discover more things. Games, pictures and words are aids to perception provided by parents and teachers, claims Gibson [18]. Books in the broadest sense, are materials. The shape of the book and its characteristics are absolutely related to the evolutionary stage of people and the ways humans communicate. As long as humans communicate not only vocally but also in writing, the symbols must rest on an opaque surface, on a material surface (e.g., stone, paper, plastic, wood screen, etc.), which will be suitable for use.

Obviously, some specific types of illustrated books manage to gain more relevance to the game. For Nikolajeva [19] this is the case with the postmodern book, mainly due to two components: on the one hand the relationships, and especially the tensions, between what the words say and what the pictures show, and on the other hand, because of the materiality of the books. Particularly enjoyable and playful are those books that offer the reader the opportunity to interact, such as books with moving and folding images and generally those with non-conventional materiality [19].

Augmented Reality (AR) merges real and virtual world when books and smart technology devices are used in combination. The mobile devices display on their screens, above the existing environment, artificial digital 3D objects (e.g., animals, mythical creatures, ancient renowned monuments etc.) with which users can interact in real time. Lately, except the use of mobile devices, other morphotypes of devices are used for the projection of AR pictures, such as special head mounted adjusted displays. Augmented Reality can be compared with Virtual Reality (VR) because they both create illusions, but they differ greatly because AR simulates artificial objects on the existing environment, while VR creates a completely separate not existing (digital) environment, which is totally cut off from the real environment. In this research only the AR created models are of interest.

Traditional interactive books are paper books which maintain the book format (codex), meaning that they consist of two book covers with other pieces of paper in between. However, their images come to life when with simple manipulations, the reader can lift, open, unfold, look through, open, some (usually) paper parts of the book to become a player and the book to transform into a literacy game [15]. These books have different names, depending on the kind of movement or the kind of use they permit, e.g., pop-up books, a-lift-a-flap book, tunnel books, concertinas and many others.

In the Greek book market since 2016, beside the traditional mechanical interactive books, a new type of digitally enhanced interactive books, based on augmented reality technology is present. They are a hybrid type of book, containing features from two worlds a material and a digital, just like many other products we use in our 21st century lives. They combine the paper-made book with features afforded to be used only by those who own certain kind of apparatus, i.e. smart phones and tablets. Books combining AR features can be enriched with digital content, using applications that create 3D models, permit interaction with text or even play videos. Few, at present, publishing houses in Greece have turned their attention to relevant publications using the 3D models as their main feature.

Using AR technology interactive books for educating and recreating children seems to be a vast dynamic field which can ideally provide for achieving both goals.

The main aim of the present study was to record children's perceptions about interactive books properties and affordances but to observe their reaction/s while using the traditional paper interactive book, of the mechanic type, and the digitally enhanced AR interactive book. According to the procedure the research explored which are preschool children's perceptions on traditional interactive books. Furthermore, studied which are preschool children's perceptions on AR books. Also, another target was to analyze which interactive book morphotype do preschool children consider their favor.

II. Method

Participants

The study was conducted in a preschool in a regional city of Greece. The particular preschool was chosen because the number of 5-year-olds and the number of 6-year-olds met our requirements (equal numbers) so as to establish equal in age's groups (Mean 5.5, SD=0.52, N=12). The research was conducted after the parent's consent was granted. Previous to the research, the researcher discussed with the kindergarten teacher which book subjects would be considered most appropriate to choose according to the list of interactive books available. Even though the participation of children in the study was voluntary, all children expressed their willingness in taking part to it. The day of the intervention 12 out of fourteen children were present thus twelve 5-6 year-old children were separated in two mixed age and sex groups, of 6 children each. It must be highlighted that all human data including in the present research were obtained in compliance of Helsinki declaration and University of Thessaly ethics code.

Materials: Selected Interactive books for the intervention

The few AR books that have been published so far from Greek publishers concern the acquaintance of children with the animal kingdom, with space and planets, with the presentation of important world monuments, while recently, mystery stories books and titles derived from classic literature (e.g., The Little Prince) books have been added in the same list. For our intervention, we compiled a list of books based on the following criteria:

- of a relevant theme
- easy to use
- fun to look at
- of a theme favorite to children

We first examined the available AR books in the Greek book market because the numbers and subjects are much fewer than the paper interactive ones. We decided to use the subject of Dinosaurs as a suitable theme of interest in kindergarten curriculum. After choosing the AR book we located the paper interactive book, and its suitability for 5-6 year-old children was examined, as we originally thought it might be more appropriate for children under 5 years. Finally, we decided to use it because it suited all the other criteria.

The book we chose to represent the traditional interactive books was Jo Lodge's [20] Roar! Roar! I'm A Dinosaur! ; translated in Greek with the title Playful Little Dinosaurs), a 2019 Savalas Edition, board book (Images 1 & 2).



Image 1. The cover page of the print interactive book (cover). **Image 2.** Inside picture of Stegosaurus

This book according to its editor is a “super sturdy, chunky board book with sliding tabs”. Little ones will delight at the innovative tabs that make the dinosaurs move and dance on every spread, from the swoop of the pterodactyl's bat-like wings to the swish of a diplodocus's long tail”. The book combines direct action words, simple vocabulary, with colorful illustrations, and promises to delight and excite. The English edition even has pronunciations for the names of the dinosaurs which the Greek edition didn't choose to offer.

The book selected to represent for our research purpose the digitally enhanced interactive books was Dinosaurs, a book translated and published into Greek in 2019 by Hartini Poli editions (Images 3 & 4).

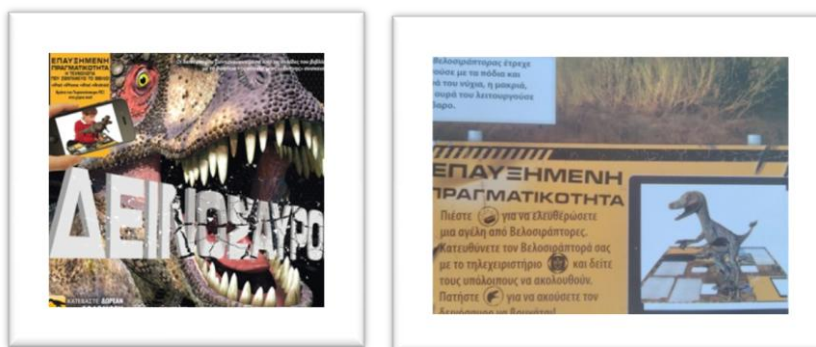


Image 3. The Augmented Reality book. **Image 4.** The AR instructions for the use of the AR

The AR book was first published with the original book title iDINOSAUR, from Carlton Publishing Group in 2013, using sources from the American Museum of Natural History, the Getty Images Gallery, and many other official organizations.

The Augmented Reality book, Dinosaurs [21], organizes the cognitive load about the theme in a hypertext format. Hypertext is considered as a new genre of information that makes reading an interactive process and enables readers to develop rich, highly interconnected knowledge structures [22, 23].

The application iDinosaurAR was downloaded prior to the intervention in two smart phone devices. Phone devices were preferred because preschool children could handle them and carry them easier than tablets which are much heavier and bigger.

Procedure

The data collection procedure consisted of seven phases:

Phase 1: Conversation with full attendance of children in a circle-time

Phase 2: Observation of children using the book and Interviews with children about their views and perspectives

Phase 3: Observation of children using the AR book and Interviews with children about their views and perspectives

Phase 4: Children presented in groups their (group) interactive book

Phase 5: Books (and smart phones) switched hands; photos with dinosaurs were taken and observed with children

Phase 6: Children decided which book they would purchase;

Phase 7: Read books. Book reading along with children repeating the dinosaur and singing of the action words suggested in the paper interactive book.

Research tools

During the intervention we used many of the tools that the Mosaic approach suggest for listening to children voices. The traditional qualitative procedures of observation and interview were the researcher's voice is 'louder' than children's sit alongside participatory tools, including children's making presentations and participating in a voting procedure in which children play an active role in discussing the material [24].

- a) Conversation with the children in a circle-time
- b) Observation during their use of books
- c) Interviews with children
- d) Children made presentations of books: discuss and review
- e) Children participated in a voting procedure
- f) Children listened to the book stories and sang the action words suggested in the paper interactive book.

Phase 1: Conversation with children

The purpose of the research was explained to children, "to see/use some books and share with me their opinion about them". The procedure was explained to them and with colorful numbered papers they knew in which group they were placed (girls and boys, 5 year-olds and 6 years-old were separated equally in the groups). All children but one stayed with their kindergarten teacher until it was time to join the researcher in the second phase.

Phase 2: Observations and interviews about the traditional interactive book with the 1st group of children

In a corner where the other children didn't have visual access, the researcher welcomed the children of the first group (group A) one by one. After a brief discussion about their interests, the researcher asked each child to look at the book twice in order to discuss about it afterwards. The aim of the observation is to note down a) the way of handling the book, b) any loud comments, and c) the degree of excitement if expressed while using the book. Finally, the children were asked in the form of a semi-structured interview the following questions in order to capture their perceptions and opinions:

- Have you seen / used another similar book in the past?
- Are you interested in the subject of dinosaurs?
- Why did/didn't you like this book?
- How would you describe this book to a friend?
- In which ways is this book different from the other books you know?
- In your opinion this book is intended for: a) children younger than you, b) for children your age, c) for older children or d) for all children?

Phase 3: Observations and interviews about the AR interactive book with the 2nd group of children

The intervention continued with the researcher coordinating the process of presenting the augmented reality book "Dinosaurs" and the implementation of the AR application to the members of the second group, group B.

The researcher first gave the book to the children, asking them to look at it. Following the "reading" of the book came the use of AR features with the mediation of the smart device. The researcher explained to the children how they would use the telephone device to "animate" prehistoric animals, discussing the instructions found in the first pages of the book with pictures and text.

The book rested open in front of the children, (as the instructions suggested) and with the help of the researcher only at the beginning they started to unbox (the dinosaurs came out of boxes or out of eggs if newborn), to move and make the dinosaurs release sounds.

After that, followed the semi-structured interview containing the next questions, in order to capture their perceptions and opinions:

- Have you seen / used another similar AR book in the past?
- Are you interested in the subject of dinosaurs?
- Why did/didn't you like this book?
- How would you describe this AR book to a friend?
- In which ways is this AR book different from the other books you know?
- In your opinion this book is intended for: a) children younger than you, b) for children your age, c) for older children or d) for all children?

In addition to the above questions Group B children were asked:

- How would you suggest another child to learn about the lives of dinosaurs a) by using this AR book or by watching a film?

Shortly before the end of the second phase of the intervention, the researcher had recorded with notes the reactions children made during the use of the application.

Phase 4: Presentation of the two books to the two group members

The second part of the intervention, after the children's lunch break, was followed by the prearranged procedure. The children of each group resumed the comments made earlier on seeing and playing with the book with the researcher's boost and help. During the presentation all the positive or negative features of the books were indirectly identified.

Phase 5: Books switched hands

In this phase children switched books and all children had the opportunity to observe these interactive books and use the AR application. Children had taken photos in groups with the dinosaurs and then watched them all together in the school PC (Image 5).



Image 5. Photograph of children with AR *Pterosaurs*

Phase 6: Children decided which book they would purchase

In the circle again, children voted which book they liked most and they would like to purchase.

Phase 7: Book reading

In the circle, the researcher and the kindergarten teacher read extracts that children pointed out from the rich in information about dinosaurs AR book and then read the short text from the paper interactive book. Finally, just before the end of the school day program we all played dinosaur making their movements and sang the action words suggested in the paper interactive book.

III. Results

Having leafed through the paper interactive book once, the researcher urged children to look at it once more, especially those children who did not discover its augmented possibilities with the first leafing. After that the researcher place her finger in the first indicated spot (circle with an arrow as indicator), all children managed to move the different part of the movable pictures. One girl wasn't very pleased with two sliders which couldn't move as easy as the other. Again, children who had previous experience in playing games with smart phones and tablets were more familiar in using the devices and the AR application.

The group using the AR interactive book started looking at its textbook on their own pace before using the AR application in conjunction with the paper book. When looking at the textbook two children made some oral comments, e.g. "I know that dinosaur" or "this dinosaur is very mean" and other expressing that they were already familiar to the subject of dinosaurs. While holding the smartphone they followed the instructions with the right order. They all pressed the right pictograms to unbox the animal and saw the first dinosaur. All children seemed really amazed at the beginning. As they went on in trying to move the dinosaurs around the room, on the table and under it they got more frustrated and disappointed asking loudly "Where did it go?" "Where are you?"

Talking with the children who formed the paper interactive book group we found out that only two of the six children have seen another similar book before. All children liked the subject of the book and said that they liked the book but couldn't find the words to express why exactly. One boy said, "Because I like dinosaurs" and another boy said "because they move". The same answers were given in the question "why this book is different than others". Only one answer was different by a 6 year old boy:

Boy (6 years-old): {Because this T-Rex}... is shouting and I hear this!

When asked "what do you mean you hear the animal?" the boy pointed at the black parallel lines appearing in front of T-Rex's mouth, when sliding the arrow down in order for the mouth to open (Images 6 & 7).

In other questions related to the description of the book to another child they commended on the animals' details (sharp teeth, big, pointed thorns, great horns, powerful tails etc.). A girl (6 year-old) noticed that half the dinosaurs in the book were happy and the others were angry.

Girl 6 year-old: "{the book is} ...about angry and happy dinosaurs".

Finally, most of the children said that the book can be used by all children younger and older than them.



Images 6 & 7. The three black parallel lines make the dinosaur "get alive" (6 year-old boy)

From the discussion with the AR interactive book group it was revealed that two children two children have seen a book about dinosaurs before but none an AR book. All children liked the subject of dinosaurs. When asked to say why they liked the AR book, all children forgot to mention the book and mentioned the Augmented Reality Application and the chasing of dinosaurs.

Although anxious to see the new kind of book, children were enthusiastic at the beginning but didn't preserve their interest as the time went on. They implied that the content was limited "it was nice but couldn't see all dinosaurs moving" said a 6 year-old child.

Releasing the dinosaurs was easy (by pressing the box pictogram). Making the dinosaur roar was quite easy as well by pressing the voice button. Taking photographs was easy too. Keeping the dinosaurs in screen was the most difficult of all. None of the children could "land" the pterosaur on the table or make them fly towards a certain direction.

Following the observation and the discussion procedures, phases 4-7 where very fruitful in results. Presentation gave a great opportunity to children to describe what they have seen and experienced. Group A highlighted that the book they used was "nice" and described its subject "it had dinosaurs' images", and then its novelty "you can make them move if you put your finger on the arrow and move it up and down". The boy who mentioned in the interview that it seemed like he could hear them, mentioned that "when moved they looked like real". Group B mentioned that the dinosaurs came to be alive, that they couldn't see them all the time that they were small;

some mentioned that one of them came out of an egg, while other dinosaurs were flying and had very loud voices.

The switching of the interactive books renewed children's interest but was a fine opportunity to confirm the results already noted down by the use of books from the other groups, as well. Thus, during the use of the AR book from Group A and the use of the paper interactive book from Group B, the researcher observed and kept notes while the kindergarten teacher provided help to the Group A with the use of smartphone. The results were the same with the use of the movable book (children looked at it and played with it more than one time) and similar with the use of the AR book. The procedure included photograph taking and photograph viewing in the big screen of the preschool's computer (Phase 5).

When children were asked to vote which book (Phase 6), they liked the most the paper interactive book won the most sympathy (8 voted in favor and 4 against).

Finally, we completed the intervention by reading the books and by word-playing with the paper interactive book suggested sounds of dinosaurs' movements which worked as action words for us (Phase 7).

IV. Discussion

Our study provides new insights, concerning the use of traditional and AR interactive books by kindergarten age children:

1. The use of interactive paper books is not intuitive by preschool children. Neither is the use of AR books.

2. Preschool children's fine motor skills are not yet ready to use the fine touch screen movements needed to handle an AR object.

3. The interactive features of AR books are not tangible compared to traditional interactive books' features. They seem to be present, but they are intangible. Although these features relate to the imaginative worlds children in which enter and live as "player-readers", children by the age of 5-6 still need to use tangible toy-books.

4. Interactive children's books are multimodal books. Their use provides an excellent opportunity to get acquainted with the semiotic modes, such as the written word, images, moving parts, sounds, indicators and other features they are important to learn.

Visual attention is considered to be the primary cognitive mechanism involved in information search [25]. But as it was proved children's perception of interactive books qualities and especially the ability, that they give to children to move some of their parts, can be understood in relation to motion [26].

Using the paper interactive book requires understanding of its potentialities and using small muscle movements as well as eye hand coordination. Even though the paper interactive book that was chosen for the research had in our perception simple and obvious features, children who hadn't previous experience in using such books weren't able to use it without help. One step further, the difficulty in using the moveable parts of the board book meant that they were not aware of the role indicators (e.g. such as arrows) play in the context.

Engaging 5-6 year-old children with AR books and teaching new abilities with mobile technology turned out to be a funny and an interesting way to capture preschool children attention [27]. Although the AR book editors' intension was to enrich the text and provide film-like material without projectors, projecting surfaces, cd-players etc., the information offered for dinosaurs through using the smart phone appeared to be of little cognitive value and confusing as one child thought that T-Rex was a small animal and another child called "pet" names to the pterosaur, probable having the same belief.

All dinosaurs were at first in "boxes" and children could "unbox" them. Among the instructions were the sentences "press the box (pictogram) to release a dreadful T-Rex" and "press the box (pictogram) to make the mighty Pterosaurs fly", giving in this way the dinosaurs control to the user and to the AR application a playful aura.

AR books were perceived by children as a nice way to have fun. Although rich information can be added to AR books in a unique way, which until now no paper interactive book could afford, the Dinosaurs AR book was experienced with enthusiasm in the beginning but soon problems of operating the movement of dinosaurs and the agony for keeping them in the screen interrupted and reduced the children's enthusiasm. It is assumed that if the experience was not a group one in the final circle time, the AR book use would be even more frustrating for the children.

Even the smaller interactive picture books are not to be thought as simple and for short use [17]. The observation pointed out this element as well as children "read" and "played" with the paper interactive book again and again.

Even though the AR book seemed to be more promising for engaging children's attention longer this was not possible due to the constraints imposed by the very delicate screen handling.

Our data are contributing towards the selection of criteria under consideration when deciding which interactive books are more suitable for preschool children.

The current research introduces a new way of studying interactive books, traditional or based in AR technology. Even when unfamiliar to both kinds of books, children used easier and with fewer constraints the paper interactive book on their own and by the company of classmates. This flexibility serves and further promotes fun experiences. The observed result was orally expressed by children as well. Children vocalized their preference to the traditional interactive book. This book allowed preschool children use it not only by looking at pictures but also by playing with it at the same time, transforming the reading experience in a joyful experience as well. Books that children can look at and play with must afford certain qualities. They must be easy to grasp and transfer, easy to use. Paper (or other material) image books as detached objects offer these qualities and even though children can't read, they can use them to gain perception through the images and the other mechanical features they offer.

Very few children can perceive the use of interactive books if not helped. They need other persons' help and guidance in order to use and elaborate the richest affordances of interactive books because the most of their features are not intuitive to use.

V. Limitations and future directions

The present research can be expanded and repeated with the same or different morphotypes of interactive books to younger or even older children as to elucidate which are among their properties are the most useable and beneficial.

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