



ReadAR, Playful Book Finding Through Peer Book Reviews for Multi-faceted Characters in AR

Lars Wintermans¹, Robby van Delden²(✉) , and Dennis Reidsma² 

¹ Creative Technology, University of Twente, Enschede, The Netherlands
l.j.wintermans@student.utwente.nl

² Human Media Interaction, University of Twente, Drienerlolaan 5, Enschede, The Netherlands
{r.w.vandelden,d.reidsma}@utwente.nl

Abstract. One important element to provide reading enjoyment and to persuade children to read (more) is providing children with books that fit their interests. We structure filtering and recommendation of books in a playful way via animated 3D characters. These characters have an unusual mix of characteristics that can be related to categories of books, while at the same time aiming for overcoming a filter bubble effect. In our Augmented Reality application the characters playfully ‘structure’ the process of book review and searching. We tested the prototype during two within-subject sessions, testing reflecting on the book as well as searching for books, with respectively 18 and 15 participants. When comparing to a regular ‘writing a book report’-approach, children indicated they would more likely want to use the app again for providing feedback about the book to peers as well as for finding books. Although they wanted to look again for the books and watch the accompanying localised video reviews from their peers, almost half did not want to record videos themselves again which points out a clear challenge for future improvements.

Keywords: kids · library · play · books · reading · AR

1 Introduction

Dutch primary and secondary school children have the lowest reading enjoyment level of all 79 countries participating in the Programme for International Student Assessment (PISA) 2018 research [8]. This is an alarming statistic, because reading enjoyment positively impacts the development of reading skills [22]. To make matters worse, there seems to be a negative trend, with reading enjoyment levels being lower than in the PISA 2009 [8]. This could be the result of decreasing skills which might be attributed to an increase of reading short texts (e.g., text messages) and a decrease in reading long texts (e.g., books) [8, 23]. As the report of the Dutch council for culture and education summarizes: ‘*It is*

an important joint task to stimulate reading and make motivation for reading a spearhead [23].

Merga [19] showed that finding the right engaging books is important to create reading enjoyment. Children in that study (aged 8 to 11) commented that they have difficulty finding books that suited their taste. Several primary school educators reiterated this problem when interviewed as part of our current study.

Adding pleasure to the process of visiting libraries and finding books is thus not surprisingly a recurring research topic. There are large scale interactive systems that facilitate browsing through a set of books, such as the camera-projection floor surface of the StorySurfer [7], audio playback and recording devices to leave –and listen to– reviews in public libraries [18], or interactive technologies such as new or free apps in school libraries (co-designed) by children [12]. The StorySurfer project emphasized the role of some physical movement within the browsing process [7], the BibPhone emphasized the link between digital and physical [18], and Itenge-Wheeler et al. emphasized the importance of school libraries. For our current project we combined the focus on in-school libraries with movement and location-based personalised interactions using smart devices.

In a typical library setting, the number of books is too large to scan through. Therefore, besides providing pleasure, a practical focus in this domain is often how to support browsing and dealing with (category-based) filtering in child-friendly ways to keep the number of books manageable for the child. For instance, the well-known participatory design work related to the International Children’s Digital Library (ICDL) [10,11] details how they, together with children, came up with properties and categories such as reading age, colour, and length. This led to insights in how these can be integrated in screen- and child-friendly ways with various trade-offs. Whereas Hutchinson et al. focused on children actively browsing based on book properties, we instead facilitate exploring based on a few reader ‘personas’. This is similar to the approach of stores like Amazon who base book recommendations on the preferences of “other people like you”; however, it is known that this approach may suffer from the filter bubble effect [21]. We show how we address this by making personas that are not too precisely constrained.

In our study we build on these starting points from related work. Similar to [29] who built their application from theories on play and child development [27], we are also targeting a playful experience and state of mind [1] building on the elements of the PLayer EXperiences (PLEX) framework [14,16]. Following standard HCI practices [15] we use interviews, surveys, and other feedback from children, teachers, and a library expert. After discussing context and related work, we will explain the ReadAR design rationale, and present the setup and results of our study comparing the ReadAR application to typical approaches currently used by the school, and end the paper with a discussion.

The main contribution of this paper is the context-informed concept of combining peer book reviews with multi-faceted animated characters as a possible direction for steering children towards finding books that fit their interests.

2 Background – Playful Experiences for Finding Books

We build on related systems that go beyond traditional screen-based search for finding books. We also used information obtained from experts and children, as will be discussed in the next section.



Fig. 1. The ReadAR app explained in three pictures. On the left, a (translated) screenshot of the application. In the review mode, the child picks a character that fits the book that was reviewed, and in the search mode they pick the character to search by. For this character visualisation we customised Mixamo’s Mousey animated 3D model, assigning different looping animations and colours. In the middle, an example of using the tablet’s camera while walking around, the child sees the selfie-based book review by a peer connected to the book of interest. On the right, a school library with books having the AR markers attached, to identify the books currently available in the system.

With *the StorySurfer* children search for books in the library [7]. It consists of one big floor surface that they can stand on, and a tabletop. Various book covers as well as search interfaces are projected on these surfaces. Children can use multiple themes to search by stepping on buttons and moving around. Based on the input, similar to a Venn diagram, books that fit several themes are in the overlapping part of a visualisation. By keeping the focus on one book for a longer time on the floor, the book is selected and ‘sent’ to the tabletop where they reveal new properties such as information about the author, a summary, and related books. The StorySurfer seemed to foster social interaction, partly because multiple users can use it at once. This created the opportunity for children to ‘look over the shoulder’ of others, potentially broadening their horizon.

With *the BibPhone* children can add audio annotations to books, which other children can listen to [18]. By scanning RFID tags a child can either listen to what was recorded onto the book or leave a message behind for someone else. Reviews were provided by school classes of children that were invited to the library. Evaluations showed that children liked listening to the recorded messages on the books. Recording messages themselves, however, was often found to be embarrassing by the children. This ties in with an important issue for user-generated content: such systems are only as interesting as the content on it.

The Department of Hidden Stories (DoHS) aims at storytelling and improved engagement in a public library [29]. Children can create information relating to books to be added onto the physical books via their barcodes. The concept revolves around triggering storytelling and includes *character cards*, suggestions to include a fortunate or unfortunate event, as well as instructions for content such as ‘where does the story begin?’. The generated stories are related to the books the children find in the library. There are two modes, one to *create* stories and one to *discover* stories of other children. How the story is structured is left open but in their evaluation children showed many key points of stories.

With *the Search Wall*, children can physically create their search with a combination of tangibles [5]. For instance, rotating cubes with icons, rotating knobs, and placing physical puppets (animal characters) that represent a media type (e.g. comics [6]). On the central screen search results are shown in the order of their popularity, scroll-able via knobs.

The ReadAR application is different in the following ways: we make use of video and Augmented Reality, work in an in-school library, and have a different approach to finding books (described later). Similar to related work we deliberately include active movement and relation to the physical environment for exploring different books. We also include listening to another child’s review, also with the aim to foster (mediated) social interactions. Similar to the approach of the BibPhone, we include recordings of a book review by fellow children, and similar to DoHS we do this by having a *search* and *book review* mode. To further increase chances to generate interesting content, similar to DoHS we included suggestions for content. For our case, as is also described in our context analysis, we build on the traditional written book report forms.

3 Context Analysis

During the project we were informed by three teachers of the primary school that participated in this research, each with more than 20 years of experience, and by an education coordinator of ten public libraries. These interviews were held online, as an unstructured interview. The interviews included discussing what children do when they are looking for a book, the motivations for choosing a book, and what problems the children experience when choosing books. Additionally, a survey was conducted among primary school students.

3.1 Teachers and Expert on ‘Children Choosing Books’

The interviewees mentioned that most children primarily look at the cover of the book, and furthermore at font size and images inside. One teacher mentioned that children look at the number of pages, sometimes looking for the thinnest book possible. The blurb on the back is often ignored. These findings fit with Reuter’s study on (digitally) choosing books with the ICDL [26] and other studies [9, 10]. Out of seven dimensions analysed by Reuter, the one mentioned as the biggest influence on book choice was the metadata and physical entity of the book (e.g.,

title, cover and front matter) [26]. Literature does show differences exist between age groups, where these findings fit our target group of early elementary children whereas older children are expected to make more use of summaries and genres [9, 10].

One teacher mentioned that some children have no systematic way of choosing books, but simply walk up to the shelf corresponding with reading level and choose a random book, putting it back when the cover does not appeal to them. Level of difficulty was also part of the second most prevalent decision factor in Reuter's study, the 'accessibility dimension' [26]. In the school library of the interviewees, bookshelves fit reading level, but were not sorted by theme.

Finally, a teacher remarked that children influence each other when choosing books. When his students spend more time in the library, they start conversations and recommend books to each other. This fits with older children indicating to rely more on their friend's than teacher's recommendations [9]. Our ReadAR application uses this by having other children suggest and give feedback about books. Our system also acknowledges the difficulties of children with lower reading levels, where we for instance link this to liking books with many pictures.

3.2 Teachers and Expert on 'Problems Experienced by Children When Choosing Books'

The teachers identified multiple problems that pupils experience in their decision-making process. One of these is choice overload, which might reduce the quality of the decision [4]. Libraries offer so many different choices that children often do not know where to start. Children furthermore often lack the verbal tools to describe which books they might like. They might *know*, but lack the tools to define their taste. A teacher or librarian could help them discover their literary taste, by asking questions and guiding them in finding a suitable book. However, several teachers stated that while they would love to help their students find a good book, they simply lack the time to do this for all students.

Teachers also stated that some children are *unmotivated* to make an informed decision on what book to read. The process of choosing a book is deemed unimportant. Children often do not examine the contents of the book, but instead focus on external things like the cover images and the size of the letters.

Finally, according to the library education coordinator, the typical setup of a library, with rows upon rows of book spines, makes it hard for children to see what is available and thus choose a book; they need more information. The library does try to address these things, for instance by placing some books with the cover towards the outside, but this is not sufficient.

3.3 Survey on Finding Books - Fun and Difficulty

We conducted a survey among pupils of the participating school, to get an idea of their experiences or attitude towards the library and towards choosing books. We focused on how easy and fun they consider the process to be. Similar to [3] who targeted 8-12-year-old children, we used Likert-scale questions. After obtaining

approval from the CIS ethical committee of the EEMCS faculty under RP 2021-14, respondents were recruited via the participating school. The teachers of the students then distributed the survey to those children for whom we had written consent by their legal representative and approval for use of videos. Of the 40 participants, 25% were in the Dutch fifth grade (equivalent to US school system’s third grade), 37,5% in the sixth grade, 20% in the seventh grade and 17.5% in the eighth grade.



Fig. 2. Translated responses of the children (5th-8th grade) on a 5-point Likert scale about fun and difficulty while choosing and finding books (in any type of library).

Although we did not use a validated questionnaire, we did investigate reliability of both constructs. The first construct, the amount of fun experienced while choosing books, achieved acceptable reliability, with Cronbach’s $\alpha = 0.896$. The second construct, the experienced difficulty of finding books, had a lower but still acceptable reliability, with $\alpha = 0.742$. Removing the statement ‘*I know well what kind of books I like*’ would result in an improved $\alpha = 0.761$.

Responses to the question ‘*Why is [this] your favourite book?*’ were all quite short. Children made two common arguments: a book being exciting/thrilling, and a book being funny, but not with strong reasons for why they liked a book. This fits with the expert interviews indicating it might be hard for a child to verbalize their taste. Many of the arguments focused on only one or two aspects of a book; whether it is funny, thrilling, has nice images, or is adventurous.

The results seem to indicate that the problems that children experience while looking for books are not that related to knowing what books they like, nor to a lack of enjoyment when looking for books. Rather it seems that there is some difficulty in finding fun books and some resistance to going to and enjoying the library. Elements we hope to address with the ReadAR application by providing and going through recommendations in an ‘exploring’ way.

4 ReadAR

ReadAR was designed building on the related work and expert input, taking PLEX elements [14, 16] into account¹, as well as design input from one teacher.

¹ During our design iterations we primarily took into account captivation, completion, control, discovery, exploration, expression, fantasy, humor, and sympathy. For

This teacher also helped to inform us on the types of books to be included. ReadAR was made in Unity and runs on an Apple iPadAir (2019) due to availability and support for ARfoundation (i.e., ARkit for Apple devices). The ReadAR app consists of two modes: a *book review* and *search* mode, similar to [29].

4.1 Four 3D Characters

In ReadAR the children have to think about what type of person would enjoy a certain book, expressed by choosing from a limited set of four virtual 3D-animated characters (also see Fig. 1) with specific characteristics. The same characters are used when looking for a new book to read. We recognise that ‘reading stereotypes’ attached to the character could actually have negative effects on children, such as filter bubble effects. To prevent this, we choose the reading stereotypes to be broad yet specific, aiming to have all children finding a reading stereotype they can somewhat relate to, or at least relate a book to. We furthermore avoided visual attributes in the stereotypes that might alienate certain users on things other than reading preference. Striking a balance between having enough options to choose from and having enough books per character, four stereotypes were created in discussion with the teacher. In the app, the characters introduce themselves and which types of books they like, see Table 1.

Table 1. The four types of characters in the ReadAR app, targeted to not fall too much towards stereotypes but rather covering a wider range of books.

Name	Type of books	Description
Peep	Funny books, sports books	I don’t love reading... I’d rather go outside to play! If I have to read anyways, I’d want a funny book, or a book about sports!
Fluff	Thrilling stories, fantasy books, history books	I like reading a lot! Especially thrilling stories. I also enjoy books about magic, and about the past
Pow	Realistic books, non-fiction books	I enjoy books that could really have happened. I also really like books with information!
Pika	Picture books, comics, books about animals, funny books	I think reading is quite hard... That’s why I like when there are a lot of graphics in the book. I also really like books about animals!

instance, the characters’ traits are intended to be relatable and triggering emotional feelings, similar to the suggestion in [14] that Sim characters might trigger sympathy.

4.2 Book Review Mode

The reviewing of a book upon is supposed to happen upon returning it, and consists of three main parts: taking a picture of the book to be returned, choosing a character to which the book fits, and making a video telling why this book belongs to this specific character. Similar to [29], these child-generated materials are then used in the search mode.

The app starts by showing the camera feed with the instruction: ‘*Create a picture of your book*’ and a big red button to take the picture. The child can then navigate the four characters with two arrows, see Fig. 1. The third step consists of recording the video. The camera feed is put in selfie-mode, and the child needs to press and hold a red recording button to start recording the video, which is indicated with an instruction at the bottom. On the same screen, some cues on what to say were added: on top as main instruction ‘*Tell <Name character> whytheyshouldfindthisafunbook*’ and next to the selfie-feed ‘*What did you think about the book?*’, ‘*What is the book about?*’, and ‘*What type of book is it?*’. These are the same questions that are on the traditional book report that the children commonly used.

For recording and saving the picture of the book and the video, the NatCorder and NatShare APIs were used to record video and save it to a specific folder.² The photos and videos that were recorded were kept on device, with each video saved in a specific folder, representing the character the child has chosen. These videos were (for now still) manually added to the AR experience in the search mode based on markers and on basis of the book cover.

4.3 Search Mode

Finding (or: looking for) a book starts with the user choosing a character that fits them. This is essentially the same interface as when returning a book, with the descriptive text on the top of the screen changed to ‘*Choose a character to choose a book with*’. After this, the interface becomes a viewfinder. When the user hovers the tablet over one of the markers attached to the books that fits the character they are looking with, a video of their peer who created a book review on that book starts playing, see Fig. 1.

5 Method

To evaluate whether the prototype helped children choose books and made the process more fun, we tested the prototype during two within-subject sessions with respectively 18 and 15 participants.

Children were selected via a familiar teacher in the participating primary school, inviting two classes of this school (Dutch fifth and sixth grade). These were children from the age of 8 until 11 (same range as [19]), $\mu_{age} = 8.9$ with

² NatSuite “NatCorder AP”, <https://docs.natsuite.io/natcorder/> and NatSuite “NatShare”, <https://docs.natsuite.io/natshare/>, accessed on 18th of June 2021.

$\sigma = 0.96$, including 7 boys and 11 girls. To provide more comfort for the children, the tests were done with two children present each session at the school's library. Legal representatives signed both the consent form and separately we asked for consent for use of the video recordings in the study, accessible only to the involved participants during the study and to the involved researchers for a minimum of 10 years. This study including expert interviews was approved by the ethical committee of our faculty.

In the first session we focused on the reflective part of the experience. Children were asked to review a book of their choice with the ReadAR prototype, and to fill in a book report³. The latter was seen as the baseline alternative, as this was currently in use in the primary school to make children reflect on book choices. In the second session children were asked to find a book using the ReadAR prototype and compare this to the current baseline of finding a book without the help of the prototype.

Measurements mainly built on the Fun Toolkit [24, 25]. The first form consisted of four parts. An adapted *smiley-o-meter* [25] to measure fun (translated and with revamped visuals, analysed with Wilcoxon's signed-rank test based on non-parametric characteristic of visual rating). A place where children could give the activity a grade (based on their experience a 1-10 scale, using a t-test, assuming a reasonable continuous scale with meaningful equal distances). Finally, there were two open questions where they could write down what they found the most and least fun (first author coding recurring responses and providing counts). For the second session, a question was added concerning why they chose the book they did, and a Visual Analog Scale (5-point scale from very hard to very easy, using Wilcoxon's signed-rank test) for experienced difficulty when looking for a book. After exposure to both situations, another form was used to compare the two experiences. On this form, the participants had to pick their preferred situation. In addition, this form included an again-again table [25]. For each of the elements of the experience, children could state whether or not they wanted to do it again. For example, the elements in the again table for the first evaluation session were: choosing a mouse (character), recording a video, writing down what the book is about, giving the book a mark, using the iPad app, and filling in the book report.

While the children were using the ReadAR prototype they were observed, during which we paid special notice to playful behaviour. We made a draft observation scheme with anticipated playful elements. Unfortunately, details are outside the scope of this short paper (although we do briefly look at its potential in the discussion). In total the sessions took six hours spread over two mornings, during both mornings the sessions with two children directly following each other.

³ We used an online randomizer to decide who started in which of the conditions. After each of the conditions they filled in the evaluation forms. In the second session, about finding books, three children could not make it to school due to sickness(-related) reasons.

6 Results

We did not observe a significant difference in the reported amount of fun experienced when comparing reflecting through a book report with reflecting through the ReadAR prototype (Wilcoxon's signed-rank test, $Z = -1.883, p = 0.060$). However, the participants (61.1%) did report that they experienced more fun using the prototype as compared to writing the book report. This fits with the again-again table where 12 (out of 18) wanted to use the app again, 6 maybe; whereas only 3 wanted to use the book report again 12 maybe and 3 not again. There was no significant difference found in the overall grade given to the experience ($\mu_{report} = 8.21, \mu_{app} = 8.94, T = 1.553, df = 18, p = 0.139$). Children enjoyed the characters that were included in the prototype, with 77.8% mentioning this as their favourite part of the application. The children disliked recording the video review, for 66.6% their least favourite part (besides mentioned as least fun in this open field, also in the again-again table 6x indicated as not again and only 1x again).

There was no significant difference in the experienced difficulty of finding a book when comparing finding a book with and without the prototype (Wilcoxon's signed-rank test, $Z = -1.633, p = 0.102$). More than half of the participants (53.3%) reported they found it easier to find a book using the ReadAR prototype. Looking at the types of reasons children gave why they chose a book: we could observe that children more frequently gave a very general motivation for their book choice when they chose a book without using the app. An example of an overly general motivation is *'it seems good'*. With the ReadAR prototype instead (nine out of fifteen times) children mentioned an aspect that was featured either as a preference of one of the characters, or an aspect mentioned in one of the reviews.

Children did experience significantly more fun when looking for a book using the application, compared to finding a book without it, based on the Wilcoxon's signed-rank test ($Z = -3.219, p = 0.001$). The majority (86.6%) of the children reported to have experienced more fun when using the ReadAR prototype. This also fits with results of the again-again table, 13 indicated wanting to do it again using the app and 3 maybe; whereas for finding the book without the app only 3 again, 11 maybe, and 1 not again. The mean grade given for the experience is also significantly higher ($\mu_{app} = 9.51, \sigma_{app} = .45$ vs $\mu_{without} = 7.76, \sigma_{without} = 1.52$) for finding a book using the application ($T = 4.571, df = 14, P < 0.001$).

Some of the favourite elements that were mentioned by the participants were choosing the characters (also 10x again), watching the videos (11x again), and looking for the videos (11x again). All children were able to pick a character that fit them, and many children even checked out multiple characters. Sometimes children got frustrated, because they thought there would be a video linked to the book, but not every character contained a review for every book.

7 Discussion and Future Work

From the evaluation with the primary school children, we see a significant increase in the reported amount of fun when using the ReadAR prototype to find a book. The children indicated to enjoy choosing the characters, looking for videos, and watching the videos. We did not record a significant improvement in the reported amount of fun when using the ReadAR prototype to reflect on a book. Children seemed to simply not enjoy recording the videos and were slightly uncomfortable when recording their review. Even though nowadays children are used to more regular video recordings (e.g., using Tiktok) this is still similar to the findings of fifteen years ago when recording audio with the Bibphone [18]. We were also unable to see an improvement in the reported difficulty of finding a book. We did get the impression that the book they chose using ReadAR was more well-considered, although we cannot substantiate this with clear data.

7.1 Limitations

To make the children more comfortable, the evaluation of the prototype was done in pairs of students. One student would start with using the prototype, the other student would start with the alternative. In several cases, this led to distraction for the student who had to do the alternative interaction, which was arguably less novel. This could have influenced how children experienced the interactions. Similar to studies with the BibPhone, for which the authors reported technical problems including range and database connections [18], we also had some usability issues. Several children did not understand that they had to hold the recording button to keep recording, which led to some frustration among them. In addition, for the first few students, the limit for the recording time was too short (30s), which was solved on the spot (120s). Finally, it was not that easy for children to switch characters as they had to close and reopen the app. In general students seemed to have no difficulty doing this, as they tried several characters. This difficulty might also be a potential strength, as it steers the user to really go through one perspective before proceeding to the next.

We did not yet analyse book choices in detail. For instance, did they manage to find a book that better fit them, and achieve the increase in pleasure of reading? We do tentatively see a possible effect that the children give a more elaborate argument for their book choice with the app. Although a different medium comparison (app vs writing) and content (reading rather than ‘scientific method thinking’) this seems to fit with Wijnen’s et al. findings when comparing a learning task done with a robot instead of a tablet, that also indicated more elaboration of answers with the more elaborate medium (there: the robot) [28]. At the same time, we see they do not yet more easily find a book with ReadAR.

7.2 Future Work: Towards Playful Child-Driven Intelligence Suggestions

We see an interesting difference of our study and design with current apps popular among children, such as Tiktok. On the one hand, rather than have an

Artificial Intelligence (AI) system decide the content-suggestion based on viewing/reading history, rather we have fellow children provide the content and filtering. We also view this approach fits with the recurring values seen in related work, such as ‘focusing on children’s sense of autonomy, agency, and empowerment’ [13, p205]. Unlike automatically learned reading profiles, the reading stereotypes were also not to be found in the real world. Together with the teacher we deliberately added elements that are a somewhat unnatural fit of an underlying stereotype, purposefully going outside characterizations of occurring profiles. This also has the practical use to get them into contact with other books than they would normally read.

On the other hand, we see a difference with the apparent fun that children can have in making and sharing videos for platforms such as Tiktok. We were fascinated to see this finding from the Bibphone still holds [18], and can only hypothesize to why this is. It is interesting to look for an alternative way of giving feedback and to retrieve why children disliked recording the video. Maybe, the children required more structure when talking about a book, or the opposite if they feel forced. Or perhaps, children feel vulnerable showing their face to others. One alternative to explore could be an avatar that repeats what the child is saying, something like the popular ‘My Talking Tom Cat’ app⁴. Another alternative is having an AR face filter to alter the face of the users to make recording a video less intrusive. This might also diminish an urge seen with Department of Hidden Stories to play ‘*the game*’ right, and a need ‘to know they were doing the “right” thing’ [29, p1891]. Which leaves us to still wonder how we can further the aimed-for playful attitude, rather than triggering a gameful mindset of following predetermined rules in such systems (cf. [17]).

Furthermore, even if we manage to trigger more playful elements, we also need to find suitable ways to measure this. Arrasvuori et al. suggest the use and creation of a questionnaire to investigate the experience [1]. Perhaps for children it might be worthwhile to instead employ observation schemes to see what kind of playful behaviours are elicited. Currently we only did this in an informal manner, with direct observations by the first author without proper checks for validity and reliability (cf. [15]). In other studies with interactive products for children, choosing the right training, schemes, and methods, authors managed to get reasonable levels of agreement, including observations of other play categories fitting interactive playgrounds [20] and Head-Up Games [2].

8 Conclusion

The ReadAR system with our participants clearly showed potential to truly change the experience of choosing a book for a child. However, some elements in the product should still be improved and need to be investigated on a longer and larger scale. We also learnt that children did not enjoy recording the videos, even though they appreciated those of others. We identified challenges and the

⁴ See <https://play.google.com/store/apps/details?id=com.outfit7.talkingtom&hl=en&gl=US>, accessed 26th of January 2021.

potential for impact of more playful ways to search books, and urge others to continue investigating similar directions.

Acknowledgements. Thanks to all the experts and especially Helma Bouman from the Z-O-U-T Library and Niels Bakker from Stichting Lezen, and also a big thanks to the children involved in particular those from the participating primary school.

References

1. Arrasvuori, J., Boberg, M., Holopainen, J., Korhonen, H., Lucero, A., Montola, M.: Applying the plex framework in designing for playfulness. In: Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces. DPPI 2011, Association for Computing Machinery, New York, NY, USA (2011). <https://doi.org/10.1145/2347504.2347531>
2. Bakker, S., Markopoulos, P., de Kort, Y.: OPOS: an observation scheme for evaluating head-up play. In: Proceedings of the 5th Nordic Conference on Human-Computer Interaction: Building Bridges, pp. 33–42. NordiCHI 2008, Association for Computing Machinery, New York, NY, USA (2008). <https://doi.org/10.1145/1463160.1463165>
3. Bekker, T., Sturm, J., Eggen, B.: Designing playful interactions for social interaction and physical play. *Personal Ubiquitous Comput.* **14**(5), 385–396 (2010). <https://doi.org/10.1007/s00779-009-0264-1>
4. Besedeš, T., Deck, C., Sarangi, S., Shor, M.: Reducing choice overload without reducing choices. *Rev. Econ. Stat.* **97**(4), 793–802 (2015)
5. Detken, K., Martinez, C., Schrader, A.: The search wall: tangible information searching for children in public libraries. In: Proceedings of the 3rd International Conference on Tangible and Embedded Interaction, pp. 289–296. TEI 2009, Association for Computing Machinery, New York, NY, USA (2009). <https://doi.org/10.1145/1517664.1517724>
6. Detken, K., Schrader, A.: Tangible information interfaces for children in public libraries. In: Lucke, U., Kindsmüller, M.C., Fischer, S., Herczeg, M., Seehusen, S. (eds.) Workshop Proceedings der Tagungen Mensch & Computer 2008, DeLFI 2008 und Cognitive Design 2008, pp. 435–440. Logos Verlag, Berlin (2008)
7. Eriksson, E., Lykke-Olesen, A.: StorySurfer: a playful book browsing installation for children’s libraries. In: Proceedings of the 6th International Conference on Interaction Design and Children, pp. 57–64. IDC 2007, Association for Computing Machinery, New York, NY, USA (2007). <https://doi.org/10.1145/1297277.1297289>
8. Gubbels, J., van Langen, A., Maassen, N., Meelissen, M.: Resultaten PISA-2018 in vogelvlucht. Univer. Twente (2019). <https://doi.org/10.3990/1.9789036549226>
9. Hawkins Wendelin, K., Zinck, R.: How students make book choices. *Reading Horizons J. Literacy Lang. Arts* **23**(2), 2 (1983)
10. Hutchinson, H., Druin, A., Bederson, B.B., Reuter, K., Rose, A., Weeks, A.C.: How do i find blue books about dogs? the errors and frustrations of young digital library users. *Proceed. HCII* **2005**, 22–27 (2005)
11. Hutchinson, H.B., Bederson, B.B., Druin, A.: The evolution of the international children’s digital library searching and browsing interface. In: Proceedings of the 2006 Conference on Interaction Design and Children, pp. 105–112. IDC 2006, Association for Computing Machinery, New York, NY, USA (2006). <https://doi.org/10.1145/1139073.1139101>

12. Itenge-Wheeler, H., Winschiers-Theophilus, H., Soro, A., Brereton, M.: Child designers creating personas to diversify design perspectives and concepts for their own technology enhanced library. In: Proceedings of the 17th ACM Conference on Interaction Design and Children, pp. 381–388 (2018)
13. Kawas, S., et al.: Another decade of IDC research: Examining and reflecting on values and ethics. In: Proceedings of the Interaction Design and Children Conference, pp. 205–215. IDC 2020, Association for Computing Machinery, New York, NY, USA (2020). <https://doi.org/10.1145/3392063.3394436>
14. Korhonen, H., Montola, M., Arrasvuori, J.: Understanding playful user experience through digital games. In: International Conference on Designing Pleasurable Products and Interfaces, vol. 2009 (2009)
15. Lazar, J., Feng, J.H., Hochheiser, H.: Research methods in human-computer interaction. Morgan Kaufmann (2017)
16. Lucero, A., Arrasvuori, J.: Plex cards: a source of inspiration when designing for playfulness. In: Proceedings of the 3rd International Conference on Fun and Games, pp. 28–37. Fun and Games 2010, Association for Computing Machinery, New York, NY, USA (2010). <https://doi.org/10.1145/1823818.1823821>
17. Lucero, A., Karapanos, E., Arrasvuori, J., Korhonen, H.: Playful or gameful? creating delightful user experiences. *Interactions* **21**(3), 34–39 (2014). <https://doi.org/10.1145/2590973>
18. Lykke-Olesen, A., Nielsen, J.: Bibphone: adding sound to the children’s library. In: Proceedings of the 6th International Conference on Interaction Design and Children, pp. 145–148. IDC 2007, Association for Computing Machinery, New York, NY, USA (2007). <https://doi.org/10.1145/1297277.1297307>
19. Merga, M.K.: What would make children read for pleasure more frequently? *Engl. Educ.* **51**(2), 207–223 (2017)
20. Moreno, A., van Delden, R., Reidsma, D., Poppe, R., Heylen, D.: An annotation scheme for social interaction in digital playgrounds. In: Herrlich, M., Malaka, R., Masuch, M. (eds.) ICEC 2012. LNCS, vol. 7522, pp. 85–99. Springer, Heidelberg (2012). https://doi.org/10.1007/978-3-642-33542-6_8
21. Pariser, E.: The filter bubble: what the Internet is hiding from you. Penguin Press, New York (2011)
22. Petscher, Y.: A meta-analysis of the relationship between student attitudes towards reading and achievement in reading. *J. Res. Reading* **33**(4), 335–355 (2010)
23. Raad voor Cultuur, Onderwijsraad: Een oproep tot een leesoffensief-lees! (2019). <https://www.rijksoverheid.nl/documenten/richtlijnen/2019/06/30/een-oproep-tot-een-leesoffensief-lees>
24. Read, J.C.: Validating the fun toolkit: an instrument for measuring children’s opinions of technology. *Cogn. Technol. Work* **10**(2), 119–128 (2008)
25. Read, J.C., MacFarlane, S.: Using the fun toolkit and other survey methods to gather opinions in child computer interaction. In: Proceedings of the 2006 Conference on Interaction Design and Children, pp. 81–88. Association for Computing Machinery, New York, NY, USA (2006). <https://doi.org/10.1145/1139073.1139096>
26. Reuter, K.: Assessing aesthetic relevance: children’s book selection in a digital library. *J. Am. Soc. Inform. Sci. Technol.* **58**(12), 1745–1763 (2007)
27. Verenikina, I., Harris, P., Lysaght, P.: Child’s play: computer games, theories of play and children’s development. In: Proceedings of Young Children and Learning Technologies, pp. 99–106 (2003)
28. Wijnen, F.M., Davison, D.P., Reidsma, D., Meij, J.V.D., Charisi, V., Evers, V.: Now we’re talking: Learning by explaining your reasoning to a social robot. *J. Hum.-Robot Interact.* **9**(1), 3345508 (2019). <https://doi.org/10.1145/3345508>

29. Wood, G., et al.: The department of hidden stories: Playful digital storytelling for children in a public library. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1885–1894. CHI 2014, Association for Computing Machinery, New York, NY, USA (2014). <https://doi.org/10.1145/2556288.2557034>