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Exploring Digitalization of Animal-Assisted Reading

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Animal-assisted reading is a form of animal-assisted activity where children interact with and read aloud to specially trained therapy dogs. Such activities have been shown to have positive impact on literacy skills, reading motivation and sense of empowerment and self-esteem in children. Mobile technologies and facets of engagement in digital reading are increasingly studied in the context of child learning and education. This short paper presents some first results of our ongoing study exploring potential ways in which mobile technology can be used to enhance and support animal-assisted reading activities for children.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**.

Additional Key Words and Phrases: animal-assisted reading, app design, child, support dog, animal-computer interaction

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1 INTRODUCTION

Animal-assisted activity (AAA) refers to any use of trained animals for the therapeutic, motivational, or educational benefit of patients [40]; as opposed to animal-assisted therapy, which is usually defined as the use of trained animals by trained health professionals to facilitate specific, measurable goals for individual patients [23].

Animal-assisted reading (AAR) is a form of animal-assisted therapy or activity, in which children read aloud to a specially trained dog (see Fig. 1). It can be delivered in various settings (group and individual) and a variety of environments, such as schools, universities, libraries, recreation centers, and hospitals (cf. [20]). There are indications that AAR activities have positive effects on participants' reading performance, reading motivation, and feelings of empowerment and self confidence [15, 27, 29].

The trends of digitalization in the field of education [38] in general, and in literacy education in particular [4, 24] create new opportunities also for AAR. As AAR can be represented as a triadic interaction between a child, a dog and a book, the book can be replaced by a variety of digital artifacts that can be used for reading interactive activities with the

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Fig. 1. AAR session: child with book, dog and its handler

dog, as exemplified in 2. In our ongoing study we explore whether and how mobile technology can be used to support and enrich AAR activities.

The above question is not only limited to the child-technology side of the triangle, but can also be extended to the animal-technology side. The field of Animal-Computer Interaction [18, 30, 42] studies design processes for animals as users of interactive technologies. In particular, dogs's interactions with tablets have been investigated [1, 3]. Therefore, introducing digital technologies in AAR interactions may have benefits not only for the child, but also for the dog (and its handler), e.g., by increasing the involvement of the dog in the activity by allowing it to interact with the technology (e.g., for the purpose of choosing a story or posing questions or challenges to the child).

These considerations give rise to the following questions we explore in this paper:

- What changes in AAR interactions when a regular book is replaced by a digital book?
- What new dimensions can employing mobile technology introduce into AAR activities for the child, dogs, and their interactions?
- What elements of digital content can help improve the experience of children, dogs, and handlers in AAR activities?
- In what ways can digital technology make the dog a more active and content participant in AAR activities?
- What are the considerations guiding the development of digital content for digitally induced AAR activities in the context of reading skills improvement and strengthening of human-animal bond?

To further the state of the art on technology-enhanced AAR, we present a general framework promoting a project¹ for developing digital resources for AAR activities for children. We use a framework grounded in the facets of engagement set out by Kucirkova et al. [24] in the context of reading for pleasure with digital books. We also reflect on the possibilities of increasing participation of dogs in AAR, drawing from ACI research.

The rest of this paper is structured as follows. Section 2 presents background on each of the three edges of the child-dog-book/app triangle: animal assisted reading with dogs for children, digital reading and facets of engagement in this context, and dog-tablet interactions as explored in ACI research. Section 3 presents the considerations and design decisions made in the development of two different mobile apps for different AAR settings: the KniGAV project

¹See www.dogtale.org

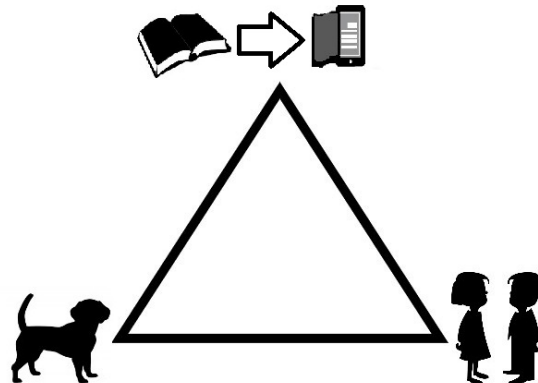


Fig. 2. Digital enhancement of AAR: the triadic relationship between dog, child, and (digitized) reading material.

in St. Petersburg, Russia and the Kelevavy project in Ra'anana, Israel. It further emphasizes the way in which the facets of engagement were realized in developing digital context for AAR. Section 4 presents a concluding outlook by discussing preliminary findings and lessons learnt in the preliminary evaluation of these apps in the field, reflecting also on emerging opportunities for future research on digitally enhanced AAR.

2 BACKGROUND

2.1 Animal-assisted reading for children

Poor literacy skills at an early age can increase the risk of drop out [16] and lead to underachievement in all academic areas; students who struggle with reading often have low self-esteem and tend to withdraw from classroom activities [11]. Integrating dogs in reading activities seem to have great potential for engaging reluctant readers in the process [28]. Indeed, as highlighted by Lane et al. [26], the dog's presence and the fact of having a direct contact with them may lead to a positive experience for the child:

“Canine-assisted reading programs can provide struggling and reluctant readers with an enjoyable and nonthreatening activity in which reading practice seems less painful.”

A wealth of research has explored the potential benefits of AAR interactions for improving literacy skills [13, 27, 32–34]. Davison explained joyful experiences of reading to dogs, developing a substantive theory [8] which suggests that reading to dogs supports children in developing a more playful and positive attitude towards the act of reading through building close relationships with the assistance animal by its non-judgmental and focused attention. Different studies of dog and child interactions have also argued that playfulness results in a positive attitude for both the child and the dog. Le Roux et al. [27] suggest that animal assisted reading programs are flexible and can be applied in a variety of settings.

Hall et al. [15] conducted a systematic review of literature in this area, focusing on the practice of reading to dogs. According to it, evidence suggests that reading to a dog may have a beneficial effect on a number of behavioural processes which contribute to a positive effect on the environment in which reading is practiced, leading to improved reading performance. However, the authors noted that the quality of research methodologies and the inclusion of appropriate controls need to be improved.

2.2 Reading in the Digital Age

Since the nineties of the past century, numerous research efforts have focused on different aspects of comparing digital books (eBooks) to regular books in the context of child education in terms of measurable literacy gains. The results are not decisive. A comparative study of tablet-based eBooks for children suggests that well-designed eBooks may aid children with learning disabilities and reading delays [37]. Further works showed a variety of advantages of digital reading [19, 39, 45], while other works have found more benefit in print books [21, 22]. Some works found little to no difference between eBooks and print books [10, 14], showing that children (preschool through elementary school) mostly learn equally well across the two media, as measured by their ability to retell the stories after reading or their understanding of vocabulary found in the stories. It is important to note that the design of eBooks is crucial for this comparison, as research has found that when eBooks are designed to be developmentally appropriate and are integrated into a school curriculum, children make greater literacy gains with eBooks than with print books [19, 45]—making it all the more problematic that poor pedagogical design is widespread [9].

While the benefits of using eBooks over print books is indecisive in terms of measurable literacy metrics, digitalization holds a great promise in terms of pleasurable reading experience. Kucirkova et al. [24] coined the term ‘story apps’, supporting such features as embedded audio and/or video, inbuilt camera and microphone, text magnification, background music, interactive elements, etc. These novel affordances of digital books can significantly alter the reading experience [12, 35], and have been found to support pleasurable reading engagements [12, 25]. In synthesising informal elements of children’s digital lives with the theoretical framework of possibility thinking, Craft [6] characterises the four dimensions of creative dispositions for learning in the digital age: pluralities, possibilities, playfulness and participation, seeing them as ‘key features of changing childhood and youth triggered by the digital revolution’. These features are the inspiration behind Kucirkova et al’s framework [24], identifying the following facets of ‘reading for pleasure’ engagement, nested within Craft’s dimensions, and are particularly brought to the fore by digital books:

affective engagement concerns how the child feels when reading. The emotional engagement with a narrative can be supported by affordances such as sensory and kinaesthetic experience of touch, audio enhancement, etc.

creative engagement is conceptualized as possibility thinking. This can be supported by giving the children opportunities to innovate, create new reading content and remix this with others’ stories, creating their own story endings, personalise the individual story characters and record their voices when reading.

interactive engagement requires a child’s active contribution. This can be supported by embedding quizzes, tasks, and other interactive elements within the storybook.

personalized engagement refers to the possibility to relate the reading material to oneself or to others. This can be supported by customization in terms of display: e.g., an image can be made bigger or the font enlarged, or personalized in terms of content: e.g., by inserting children’s names, voice-overs or ‘selfies’.

sustained engagement is linked to perseverance and the need to develop a sense of the text’s flow. This can be supported with specific features embedded in the books, such as the opportunity to take on various characters (different personas) during reading, thus experiencing a different facet of the story at each reading encounter, or providing access to additional titles or books of similar content.

shared engagement refers to the possibility of sharing the experience with others. This can be supported through joint or shared reading, remotely and/or immediately.

The above six facets of engagement provide concrete directions which we will use for creating content for digitally-enhanced AAR activity. It should be noted, however, that enhanced reading experience with sounds, animations, and games can lead to distractions and eventually reduce learning[37], and the correct balance is challenging to achieve.

2.3 Dog-Tablet Interaction in ACI research

In traditional AAR interactions, the dogs that are read to usually passive participants, trained and expected to remain quiet throughout the interaction. However, the use of technology, in particular tablets has potential not only for pleasurable reading for the child, but also for increasing the participation of dogs in the interaction.

ACI research has investigated dog-tablet interactions. Zamansky et al. [43] and Baskin et al. [2] provided an ethogram of behaviors exhibited by dogs when interacting with tablets, reflecting on the 'playfulness' of such interaction, as well as highlighting the danger for overstimulation and even redirected aggression. Following up on this work, further research explored human perceptions of dog-tablet interactions, revealing mixed feelings towards this phenomenon, and awareness of the potential dangers of such interactions [43].

Further works explored dogs' interactions with touchscreens [44], in order to study the affordances needed to make touchscreen interfaces usable for canines and help the future design of touchscreen interfaces for assistive dogs in the home. Wallis et al. [41] described a touchscreen apparatus, software and training method, which we have used to facilitate dog computer interaction, proposing such interaction has the potential to improve the welfare of older dogs in particular through cognitive enrichment.

3 TOWARDS DIGITALIZATION OF AAR

Due to the exploratory nature of our study, our approach incorporates multiple methods into an over-arching design science research (DSR). In line with the typically followed DSR guidelines [17], we start by identifying a relevant problem: supporting and enhancing AAR interactions. We then proceed to designing and developing specific technological artifacts in the form of mobile apps for enhancing these interactions. In this development we employed ideas from Kucirkova's six facets of engagement in digital reading, as well typical ACI research principles, which we describe below. The final step of this ongoing study will be conducting an in-depth empirical evaluation of the artifact in a real setting of AAR interactions—which is currently ongoing in two AAR projects: Kelevavy in Israel and KniGAV in St. Petersburg.

AAR activities are usually run on low budget and therefore require low cost equipment. It was therefore decided to develop a mobile app to be used on simple tablets, which are easily available and have limited cost. For speedy prototyping, we opted for Apache Cordova environment for mobile app development.

In what follows we provide more details concerning the two AAR projects involved, and the mobile apps developed for them.

3.1 A library of digital engagement elements

Drawing inspiration from the theoretical framework for reading with pleasure in the digital age of Kucirkova et al. [24], we devised a library of concrete elements which we then integrated in the two mobile apps developed for AAR enhancement in two different projects, which are derived specifically from the six interlinked facets of engagement:

personalized We opted here for personalization in terms of content, and used elements of inserting children's and dogs' names in the story (see Fig.5 (a), 1 and 2), and making a 'selfie' together at the end of the story.

interactive To realize this, we included an interactive quiz checking the child's understanding of what was read (see e.g., the quiz in KniGAV shown in Fig. 4). For a digital learning environment to be optimally interactive, it is important to ensure a balance between an individual's skills and the task difficulty[7]. Thus we carefully considered the content of the quiz's questions. We also made sure to explicitly exclude all judgemental elements (no red colors or unpleasant audio sounds for wrong answers).

creative To realize this, we added the functionality to record a child's own story when looking at pictures using an audio recording. The child can replay or export the story, and revisit it.

sustained To realize this, we included several books of similar content to promote a sense of flow and perseverance, so the child can revisit and choose another book to continue the reading experience.

shared To realize this, the app is installed on all the tablets used by the children, so that an interaction of more than one child with the same content is possible.

affective To realize this, we created a storybook narrating about the experience of the AAR activity, making sure the child finds it easy to relate e.g.:

"Every Thursday at 10:00 Alice comes to the reading activity with her teacher Rose and her friends. She reads to her friend Bonnie the dog, they have a beautiful friendship."

3.2 KniGAV App

Our first 'field of research' is the KniGAV project for children reading to dogs in St. Petersburg, Russia, as shown in the left of Fig 3. This project is carried out by the 'Dogs for Life' organization for canine-assisted therapy in three libraries in the city of St. Petersburg. The activity is for children between ages six and 10.



Fig. 3. KniGAV at St. Petersburg library (left), and Kelevavy at Beit haShemesh Yard, Ra'anana (right)

The first thing the children are exposed to when entering the activities of KniGAV are rules of behaviors towards dogs. We used this fact for making the reading of the rules interactive, adding a quiz at the end, making sure the child understands the rules—see Figure 4.

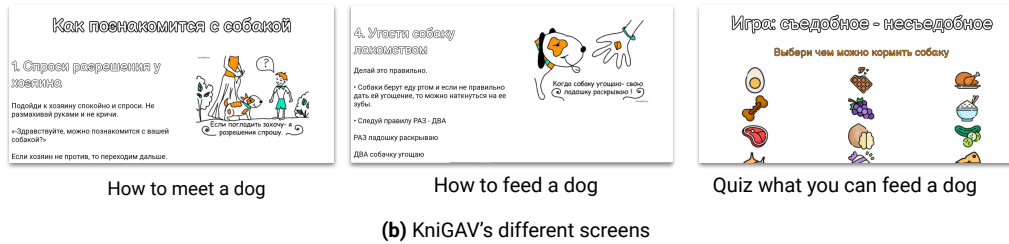
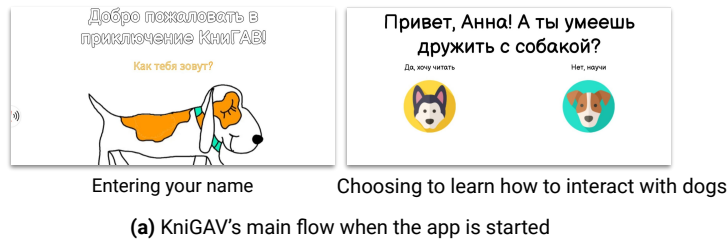


Fig. 4. The KniGAV app screens

The starting screen of the app asks the child to provide his/her name. This input is then used to *customize* the text. The child is then introduced to an *interactive* screen and asked whether he/she wants to learn the rules of interacting with dogs. By choosing 'yes', we are taken to the screens with text describing the rules of meeting, feeding and playing with a dog. Then the child is offered several *interactive* quizzes: what types of food we are allowed to feed the dog, how we are allowed to pet it, and a final quiz summarizing the rules.

3.3 Kelevavy App

Our second 'field of research' is the Kelevavy project for children reading to dogs in Ra'anana, Israel (on the right in Fig. 3). This project is part of an effort to cultivate a multi-species and multi-generation community, and is located in Beit haShemesh, a home for the elderly coping with dementia. In addition to the reading activities, the children also engage in community activities of interaction with the home tenants. The participants in the current study are a class of nine second grade children (ages seven to eight) with reading difficulties, visiting to Beit haShemesh as part of their school activity on a weekly basis together with their two teachers.

The starting screen of the app (see Fig. 5) asks the child to enter his/her name and sex (boy/girl). This input is then used to *customize* the words in the story². The next *customization* takes place in the second screen, where the child chooses the dog with whom he/she now reads. The third screen is again *customization* for the different levels of the child's literacy skills. This is particularly important for the Kelevavy setting, as the participants have varying literacy skills. The suggested activities range from recording a story, requiring practically no literacy skills but supporting *creativity*, to playing *interactive* cards, which requires reading words to digital storybooks for second grade—see also Fig. 5(b), including a storybook on Kelevavy project, promoting *affektive* engagement.

²In Hebrew the sex impacts the verbs' endings, i.e., 'says' in 'she says' is different from in 'he says'.

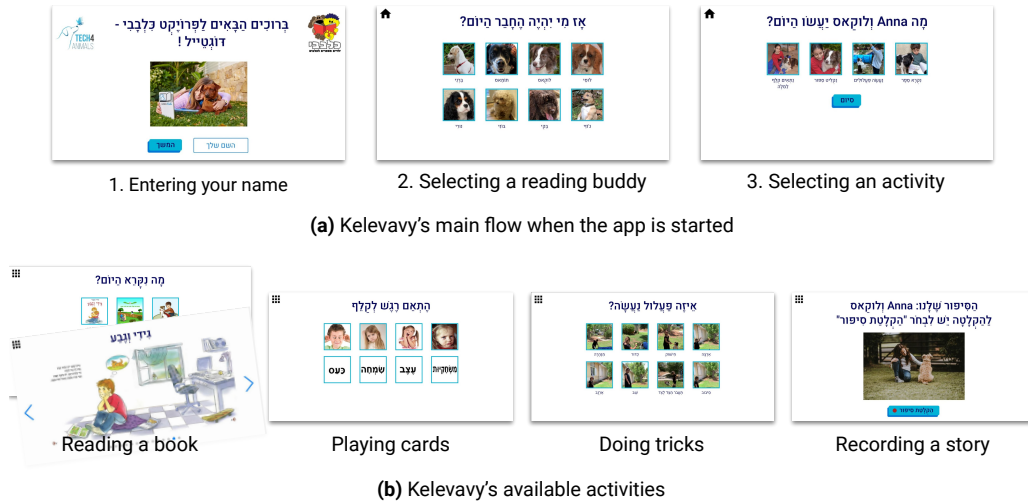


Fig. 5. The Kelevavy app screens

3.4 Increasing Dog Participation

Based on ACI research on dog interactions with touchscreens, we decided to experiment with the possibility for the dog to make choices in the app using specially designed buttons. The choices could regard the type of activity chosen ('preferred') by the dog, and/or the story the dog chooses ('prefers') to read.



Fig. 6. The dog-oriented buttons: Hi Anna, what does Lucas want to do today?

In the design of the buttons to be pressed by the canine participants of AAR interactions, we drew inspiration from Mancini et al's. [31] work, discussing how the species-specific implementation of core interaction design principles could inform the design of interaction environments for canines. The authors highlight that such principles need to take into account, as a baseline, their sensory, cognitive and physical capabilities, and the behavioral propensities that derive from those. Specifically, in terms of perceivability, dogs' dichromatic vision means that they can easily discriminate between blue and yellow (but not, e.g., between green and red). Thus we chose these colors for the two buttons—see Fig. 7.

Furthermore, Potter et al. [36] describe three main ways interfaces can be designed to accept touch interaction: land-on, where the cursor is under the touch, and only the first impact point counts; first-Contact, where the cursor is under the touch, but the first contact with the target counts even if its not the first impact with the surface; and take-off, where cursor is offset, and selections are made by where the touch lifts off the surface. Following Zeagler et al. [44], we opted³ for the first-contact interaction mode. Two of the dogs in the Kelevavy project were trained to push buttons on command using food reinforcement. It took 2 sessions, 5 minutes each to train the two dogs (Border Collie and Poodle).

4 CONCLUDING OUTLOOK

We experimented with the two apps with several participants in the Kelevavy and KniGAV projects, see an example triadic interaction in Fig. 7. We discuss below the lessons learnt in initial deployments of the apps described above at the two sites—Kelevavy and KniGAV, which we then used in the design of our (ongoing) longitudinal study exploring perceptions of the children, teachers and handlers with respect to the digitalization of AAR.



Fig. 7. Experimenting with Kelevavy app

- *Dog participation is tricky.* Experimenting with the dog-oriented buttons in the Kelevavy project, we observed that despite the fact that the dogs were easily trained to push the buttons, having them push the buttons during a real-life AAR session actually made the flow of the interaction less smooth and created an unnecessary interruption: it required the child to readjust the tablet, making it accessible for the dog, and for the handler to give the dog a command. In addition, the participants referred to 'dog's choice of story/activity', which raises the question of how a child perceives the process of the dog choosing, and whether she/he is aware that the dog does not comprehend this choice. Therefore, we decided to temporarily remove this functionality, and leave to future research both the theoretical and the practical questions of what it means for a dog to be actively involved in digitally enhanced AAR activity. But there are other possibilities to explore, e.g. asking the dogs to bring items

³The other two did not work properly in our pilot study, corroborating Zeager et al.'s design suggestion.

related to the digital story, demonstrate things related to the story, feed dogs with treats according to a sign from the app., etc.

- *Differences in dogs' AAR interaction styles can be exploited for increasing engagement.* Another insight from the pilots we held with participants was that different dogs had different styles of interaction with children during AAR. This leads to the idea for exploring these styles further and mapping them to the digital engagement elements presented in section 3.1. This is similar to the ideas by Cox et al. [5], investigating how dogs engage with tangible play interfaces, whether they manifest different interaction patterns and how these might relate to their personality. In a similar manner, the engagement elements can be customized and tailored to different ways dogs react to reading, and behave in general during AAR. For instance, more active dogs could be engaged in activities inserted in the digital storybook (e.g., asking the dog to fetch an object, and inserting an image of it in the storybook), while more passive dogs could be used for increased tactile contact (e.g., a narrative referring to grooming or petting the dog). Different interaction styles in dogs can also be mapped to differences in children's interaction styles.
- *Attending to reluctant readers' needs.* There were several cases during the pilots when children were reluctant to engage in any reading-related activity on the tablet (or printed book). To ensure they are not discouraged to use tablets, we decided to add also a digital activity for this case: videos showing tricks with dogs that the child could recreate (see Fig. 5(b)). However, the question of how to ensure that reluctant readers do not opt for this option every time remains open.
- *Customization of display is important.* Another observation was that constraints on the use of different devices should be taken into account. During one pilot at the KniGAV activity, there were no tablets available, and the handlers resorted to using a mobile phone. The children then complained that the letters were too small. In the next version we integrated a user-friendly and flexible customization of display (suggested by e.g., Kucirkova et al. [24]) as an important type of customization), in addition to customization of content.

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