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What is the impact of a multi-modal pedagogical conversational AI system on parents' concerns about technology use by young children?

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Abstract

Previous research showed that the parents acknowledged the technology's benefits for their young children's learning, however, they are still worried about the extended screen time, lack of physical activity and lack of social interactions. To address these concerns, we developed Kid Space to enable pedagogically appropriate technology use for children in early childhood education by combining various sensing technologies with a multi-modal conversational artificial intelligence system that can interact with children, understand individual progress and provide personalised learning experiences. To understand the impact of Kid Space on the parents' initial concerns about technology use by their young children, we conducted a multi-method user study: (1) a quasi-experimental design and (2) formative research method using an exploratory case study with a set of children and their parents experiencing Kid Space in their homes. The results show that after experiencing Kid Space with their children, the parents felt significantly less concerned about screen time, social interactions and physical activity and reported positive perceptions towards pedagogical value of Kid Space. Detailed analysis on the multi-modal data quantitatively and qualitatively validated why Kid Space alleviated these concerns. Future research is needed to validate long-term educational value of Kid Space and generate insights for improvement for next iterations.

KEYWORDS

game-based learning, intelligent tutoring systems, multi-modal conversational artificial intelligence, online learning

Practitioner notes

What is already known about this topic

- Play-based learning is critical for young children's education, but digital games create major concerns around extended screen time, lack of physical activity and lack of social interactions.
- Blending digital and physical spaces could support pedagogically appropriate technology use for young children. Towards this end, there are some exemplary studies in the state–of-the-art reporting positive educational outcomes as an effect of utilising such spaces. However, none of these studies supported children's most natural mode of communication in their interactions with the systems—speaking.
- Pedagogical conversational agents (PCAs) are promising, but they are tricky when it comes to young children's speech because of unique technical challenges resulted from how children use language and communicate with digital systems.

What this paper adds

- To our best knowledge, Kid Space is one of the earliest implementations of a PCA with a multi-modal artificial intelligence (AI) system utilising physical and digital learning manipulatives for maths learning with a focus on early childhood education. The key contributions of this paper are (1) the design and development of an end-to-end multi-modal system enabling Wizard-of-Oz experimentation for initial evaluations with users, (2) the creation of a multi-modal, in-the-wild labelled dataset with children–agent, children–parent and children–physical/digital space interactions enabling advancements for AI components for later evaluations with users and (3) the generation of rich insights from an initial research study on user perceptions and engagement as well as actionable findings to improve Kid Space experiences for next iterations and inform key design features for similar systems.

Implications for practice and/or policy

- The results of the study implied a set of areas for improvement—or design features—for Kid Space and other similar pedagogical conversational systems developed for children's home usages: (1) easier setup and usage with optimised setup size addressing diverse space limitations at homes, (2) minimised latency between Oscar (the conversational pedagogical agent) and child interactions (eg, adding multimodal dialogue system to reduce the need for a human wizard), (3) more advanced personalisation, social (including more verbal interactions) and pedagogical skills for Oscar with increased contextual awareness (eg, sending children's engagement), (4) scalability and higher visual quality of content with diverse games and learning outcomes, (5) parental control features over Kid Space platform and Oscar (eg, time limit, content, etc.) and (6) accessibility features (eg, captions turned on for multilingual children) and support for neurodiversity.

INTRODUCTION

Our previous ethnographic research with dozens of parents showed that they acknowledged the technology's benefits for their young children's learning, however, they still worried about the screen time, lack of physical activity and lack of social interactions (Anderson et al., 2015; see also Ahearne et al., 2016; American Academy of Pediatrics, 2016; Blackwell et al., 2014; Wood et al., 2008). With the outbreak of the COVID-19 pandemic, these concerns exponentially increased as children's screen time peaked—for some children reaching ~%500 increase (Eyimaya & Irmak, 2021; Parents Together, 2020). The findings from a large-scale survey conducted after the onset of the pandemic highlighted that 85% of the parents were highly concerned about their children's physical, social and emotional wellbeing due to extended screen time (Parents Together, 2020). These concerns range from obesity to social–emotional problems (McCurdy et al., 2010; McDool et al., 2020; Russ et al., 2009). Previously, parental control and interventions have been featured as effective methods to minimise children's screen time (Samaha & Hawi, 2017; Thompson et al., 2018). However, in a world where technology is becoming a key part of our children's daily lives—including teaching and learning at schools—there is a need for more research and development to minimise physical, social and emotional risks to children's wellbeing by design, enable pedagogically appropriate technology use for young children and consequently alleviate parents' concerns about technology use (Aslan, Li, et al., 2022).

When designing technologies for children, related research suggests the potential benefits of (1) using play-based learning activities (Arrow, 2019; Behnamnia et al., 2020; Ginsburg, 2007; Guilfoyle, 2013; Hwang et al., 2012; Jordan et al., 2009; Nacher et al., 2016; Shih et al., 2010; Singer et al., 2006; The National Association for the Education of Young Children, n.d.), (2) blending digital and physical spaces to support pedagogically appropriate technology usages (Nacher et al., 2016; see also Kang et al., 2020; Pontual Falcão et al., 2018; Salman et al., 2019 for empirical studies) and (3) using conversational artificial intelligence (AI) to support children's most natural mode of communication in their interactions with technologies—that is, speaking (see Hobert and Meyer Von Wolff (2019) and Pérez-Marín (2021) for pedagogical conversational agents (PCAs) and Graesser et al. (2017), Arroyo et al. (2009) and Chen et al. (2020) for exemplary PCAs). Leveraging existing best practices and addressing the potential gaps in the related work through design-based research, we developed Kid Space with empirical user insights from the teachers, parents and children. To our best knowledge, Kid Space is one of the earliest implementations of a PCA with a multi-modal AI system utilising physical and digital learning manipulatives for maths learning with a focus on early childhood education.

Kid Space combines various sensing technologies and uses spoken dialogue to interact with children and understand individual progress to provide personalised learning experiences in a blended physical and digital environment (Anderson et al., 2018; Aslan, Agrawal, et al., 2022; Sahay et al., 2019). We previously tested Kid Space as an immersive, projected experience in an elementary school with promising initial results that showed high levels of task engagement with less screen time, increased physical activity and more social interactions (Aslan, Agrawal, et al., 2022) when compared to traditional PC-based experiences. While we were exploring this immersive system in the school, the COVID-19 pandemic started, forcing all learning to take place at homes through online education—bringing many challenges to unprepared stakeholders (UNESCO, 2020; United Nations, 2020). To address this educational shift and these challenges, we started exploring how we could transform Kid Space learning experiences to support a home usage, keeping in mind that the setup deployed at the school required instrumentation involving various pieces of hardware, including a projector and multiple cameras installed on the wall, which would not be feasible for a home setup at scale.

To redesign Kid Space for home usages, we first conducted an interview study with 15 private- and public-school teachers in early childhood education to understand how they implemented online learning during the pandemic, the challenges they faced and the suggestions they had to address these challenges (Aslan, Li, et al., 2022). This interview study provided critical insights about teachers', students' and parents' major pain points during online learning at homes and informed decisions on redesigning Kid Space learning experiences for home usages. Our redesigned system features a playmat with tangible maths objects for the child to manipulate and an application running on a laptop computer that features an animated digital peer learner, namely Oscar (see Figure 1a). Oscar can understand children's speech, gestures, poses and interactions with objects in the physical and digital spaces and uses this understanding to enable personalised learning experiences. For Oscar's sensing and sense-making capabilities, the system utilises built-in laptop sensors (eg, camera and microphone) and a depth camera on a tripod overlooking the mat to observe and understand the child's interactions with the objects (see Figure 1b).

The physical and digital hybrid experiences are managed through a real-time system architecture and multiple AI algorithms working together (see Figure 1c). The vision module

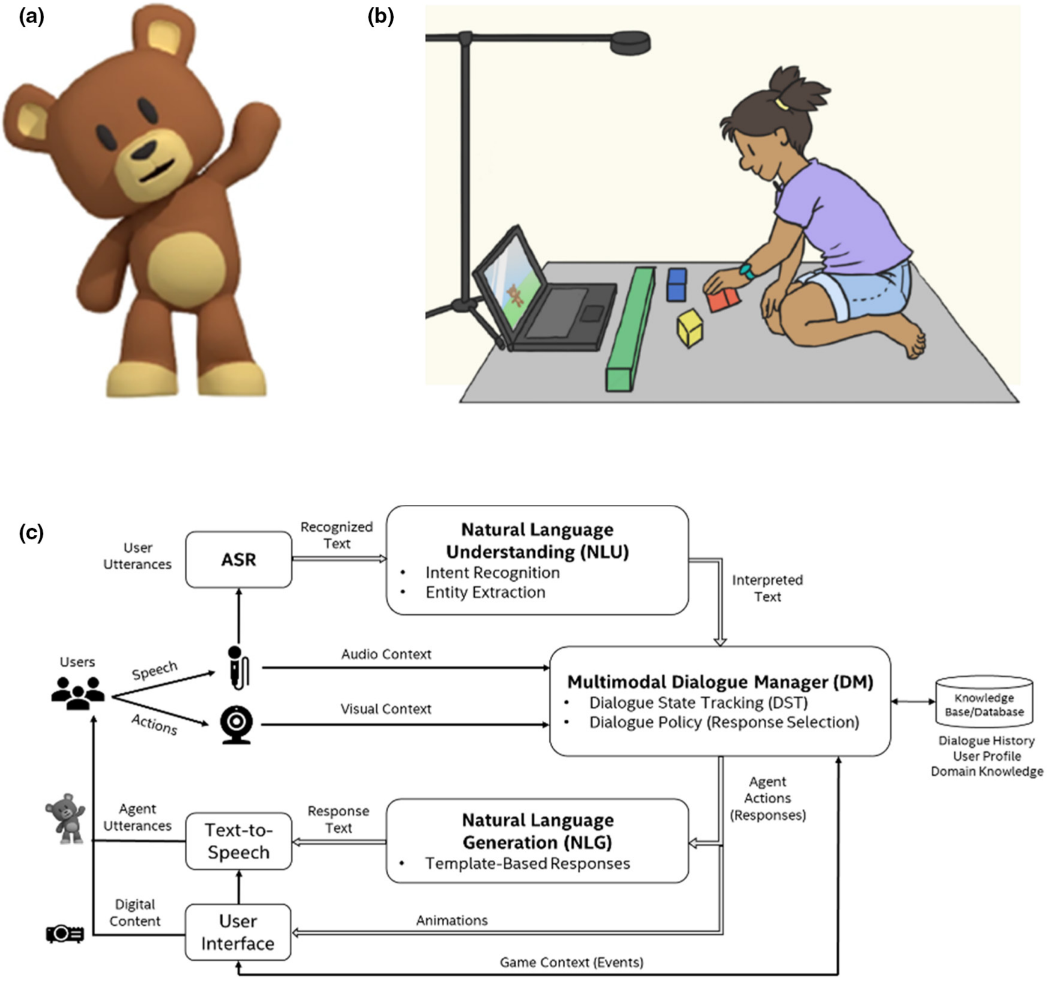

FIGURE 1 (a) Oscar, (b) layout of interaction space and sensing hardware and (c) multi-modal dialogue system.

performs object recognition to detect and count physical objects through a depth camera and gesture recognition through a built-in camera to understand the child's actions (visual context). The audio module performs automatic speech recognition to transcribe what the child says (audio context). The natural language understanding module infers the child's intent from transcribed speech and does entity extraction to interpret the child's utterances. Within the multimodal dialogue manager, the Dialogue State Tracker tracks what is happening (ie, dialogue state) and the Dialogue Policy models determine what actions Oscar should take next by performing response selection utilising the child's intent and context information from vision, audio and dialogue history. The natural language generation module constructs Oscar's utterances based on the predicted verbal response types, and the text-to-speech module vocalises them. Meanwhile, the predicted Oscar's animations feed into the game engine to be displayed in the user interface (UI).

In this paper, we outline findings from an initial user study with a set of children and their parents using Kid Space in their homes to examine whether the redesigned system for home usages could impact the parents' initial concerns about screen time, lack of physical activity and lack of social interactions while resulting in high levels of learner engagement. The key contributions of the paper are (1) the design and development of an end-to-end multi-modal system enabling Wizard-of-Oz experimentation for initial evaluations with users, (2) the creation of a multi-modal, in-the-wild labelled dataset with children–agent, children–parent and children–physical/digital space interactions enabling advancements for AI components for later evaluations with users and (3) the generation of rich insights from an initial research study on user perceptions and engagement as well as actionable findings to improve Kid Space experiences for next iterations.

BACKGROUND

Play-based learning is critical for young children's education but with potential challenges

Early childhood learning—especially early maths competency—is a critical milestone for children's education journey as it creates foundations for their academic success in further grades (Guilfoyle, 2013; Jordan et al., 2009). One of the key aspects of these early years of education is play-based activities supporting children's learning and development (The National Association for the Education of Young Children, n.d.). Such activities are critical as they nurture learner engagement with benefits on cognitive, physical, social and emotional development (Arrow, 2019; Ginsburg, 2007; Singer et al., 2006). New technologies have expanded opportunities for digital games for play-based learning (Nacher et al., 2016). Effects of playing such games on children have been investigated in prior research demonstrating positive outcomes in children's creative thinking (Behnamnia et al., 2020), which in turn could promote other 21st century skills such as problem-solving, collaboration and critical thinking (Hwang et al., 2012; Shih et al., 2010).

Despite these positive outcomes, such digital technologies also introduced new challenges especially for young learners including potential negative impacts on physical, emotional and social development (Ahearne et al., 2016; American Academy of Pediatrics, 2016; Blackwell et al., 2014; Wood et al., 2008) because of extended screen time, lack of physical activity and lack of social interactions (Anderson et al., 2015). As computing technologies have become a central part of children's lives (American Academy of Pediatrics, 2016; Shapiro, 2015; Zabatiero et al., 2018) and the COVID-19 pandemic has fuelled the penetration of such technologies at an even higher speed (Aslan, Li, et al., 2022), there is a need for further research and development to address these challenges and enable pedagogically appropriate technology usages for young children during play-based learning.

Blending digital and physical spaces could support pedagogically appropriate technology use

Research suggests blending digital and physical learning spaces to enable pedagogically appropriate technology usages for children (Nacher et al., 2016). Toward this end, in the related literature, there are some promising research studies involving this bridging of digital and physical interactions. One example of augmenting physical activities as enriched by digital experiences is by Pontual Falcão et al. (2018). The researchers conducted an experimental study with 68 children to evaluate the effectiveness of an interactive multi-touch tabletop application (with aural, visual and haptic feedback) utilising physical blocks for training basic numerical competencies. They compared this novel form of learning with traditional training conducted by a human tutor. The results showed similar significant increases in children's learning outcomes. The researchers concluded that because of the competitive advantage on children's reasonable autonomy in learning, using their system blending physical and digital spaces, could have the potential for improving early childhood learning of numerical concepts.

In another study, Salman et al. (2019) incorporated a small portable projector and a depth camera to enable young children to practice number sense concepts in early childhood education using stones as learning manipulatives with retro-reflective markers for tracking. The researchers incorporated drill and practice games for comparing different ratios with a digital agent providing audio feedback for right or wrong answers. They conducted user studies with 14 children to understand the potential effects of this mixed-reality learning environment on educational outcomes. The researchers concluded that their learning system with physical and digital interactions could promote an active, engaging and social play-based learning environment through spatial, physical, temporal and relational attributes.

As opposed to Pontual Falcão et al. (2018) and Salman et al. (2019), Kang et al. (2020) utilised a minimally instrumented setup with a tablet and a tablet stand to enable an augmented reality system for young children to practice maths problems. The researchers utilised participatory design with teachers and children to develop learning modules utilising everyday objects (eg, batteries) as learning manipulatives both in tangible and digital forms. They utilised an AI-based perception engine (through computer vision algorithms) to understand objects and their mathematical attributes in the physical space. The system was able to provide audio/visual scaffolding, procedural feedback and virtual maths tools to support learners. The researchers evaluated this system with 27 children in early childhood education and their findings showed that it had potential to promote engagement with maths learning.

Bridging both physical and digital spaces, all these systems utilised in these research studies promote visual learning through different kinds of visual stimuli, kinesthetic learning through physical interactions with learning manipulatives and auditory learning through audio stimuli (listening only)—suggesting a role for each learning modality (Barbe et al., 1988). However, none of these systems supported children's most natural mode of communication in their interactions with the systems—speaking. With new advancements in Artificial Intelligence (AI) technologies incorporating automatic speech recognition and conversational dialogue capabilities, understanding and utilising children's speech in learning processes is now becoming more possible.

Conversational AI agents are promising but tricky when it comes to young children's speech

As a part of the research stream of Intelligent Tutoring Systems, the demand from educators and learners for PCAs has increased lately (Hobert & Meyer Von Wolff, 2019). In a recent review, Pérez-Marín (2021) investigated use of PCAs in education and reported a comprehensive list of the PCAs along with their specific attributes. According to this review, different roles were assigned to the PCAs including a tutor/coach, student or companion role in various learning domains including biology, language, history and maths.

Perhaps the two most relevant platforms presented in this review by Pérez-Marín (2021) were (1) Autotutor (Graesser et al., 2017) because of its adaptive nature for supporting personalised learning experiences and unique empathetic capabilities and (2) Jake and Jane (integrated into Wayang Outpost) (Arroyo et al., 2009) because of having a specific focus on maths as a learning domain. However, both examples primarily depended on digital interactions without utilising physical learning manipulatives. More importantly, none of these examples focused on young children in early childhood education. The related research shows that working with young children creates unique technical challenges for conversational AI (Lovato et al., 2019).

Although educational robots are not a current focus of our research as a form factor, since there are some important implementations of PCAs utilising robots in early childhood education, we also specifically investigated this area of research as well. Perhaps one of the most relevant studies to our current research is the one conducted by Chen et al. (2020) because of having a focus on both early childhood education and PCAs. Using a social robot, Tega, the researchers developed a learning environment where the children interacted with a tablet and Tega engaged them in their learning journey by verbally interacting with the children. The researchers conducted an experiment with Tega and 59 children in early childhood education to understand the impact of Tega's different roles (ie, tutor, tutee and peer) on children's learning and emotional engagement. They found positive effects on children's learning and face-based emotive expressivity when Tega took on an adaptive peer role (ie, switching roles between a tutor and tutee). Like the research conducted by Graesser et al. (2017) and Arroyo et al. (2009), this research by Chen et al. (2020) did not have a specific focus on physical learning manipulatives in the space; more importantly, it did not focus on maths as the primary learning domain.

KID SPACE LEARNING EXPERIENCES

Design process

To our best knowledge, Kid Space is one of the earliest implementations of a PCA with a multi-modal AI system utilising physical and digital learning manipulatives for maths learning with a focus on early childhood education. Utilising the best practices derived from state-of-the-art as outlined above and the iterative insights from the teachers (Aslan, Li, et al., 2022), we conducted several design workshops with a multi-disciplinary team of user experience researchers, designers and technologists to redesign Kid Space for home usages. In these design workshops, we used brainstorming methods (Dam & Siang, 2020a) to (1) solidify problems to be solved through 'how might we?' questions (Dam & Siang, 2020b), (2) cluster and scope ideas, (3) define relevant personas for the experiences along with a summary of significant points of concerns derived from Aslan, Li, et al. (2022), (4) generate user insights, (5) identify relevant form factors and (6) diagram wireframe experiences along with defining scenarios of usage. In parallel to these efforts, we conducted 19 semi-structured design interviews (around 1-hour each) with three in-service teachers as subject-matter experts in early childhood education to iteratively evaluate our design decisions and improve design outcomes.

Personalised educational content with gamification

We utilised the ADDIE model (Molenda, 2003) to develop educational content for Kid Space learning experiences. Through an iterative process, we worked closely with an experienced early childhood education teacher as a subject matter expert to outline learning objectives, craft the content with question templates and build personalisation and gamification policies. In Kid Space, we focus on five major learning objectives in the first-grade maths curriculum, which are also foundational maths skills for later grades: (1) count objects using 1s and 10s manipulatives, (2) add or subtract numbers in the form of 1s and 10s using manipulatives, (3) verbally express the numbers in the form of 1s and 10s, (4) count on from 10 and (5) explain thinking process. Addressing these learning objectives, we created dynamic content with the question templates as shown in Figure 2. Note that in addition to the questions represented in Figure 2, we also incorporated an open-ended question asking children to explain their reasoning for how they solved a specific question to address the last learning objective.

We incorporated four types of personalisation in Kid Space (Martinez, 2002): (1) name-based personalisation: Oscar uses the child's name in verbal interactions, (2) interest-based personalisation: Oscar customises the content based on the child's interests (eg, selection of colour of flowers), (3) behaviours-based personalisation: Oscar observes and provides customised feedback based on the child's behaviours (eg, if the child is not jumping, Oscar

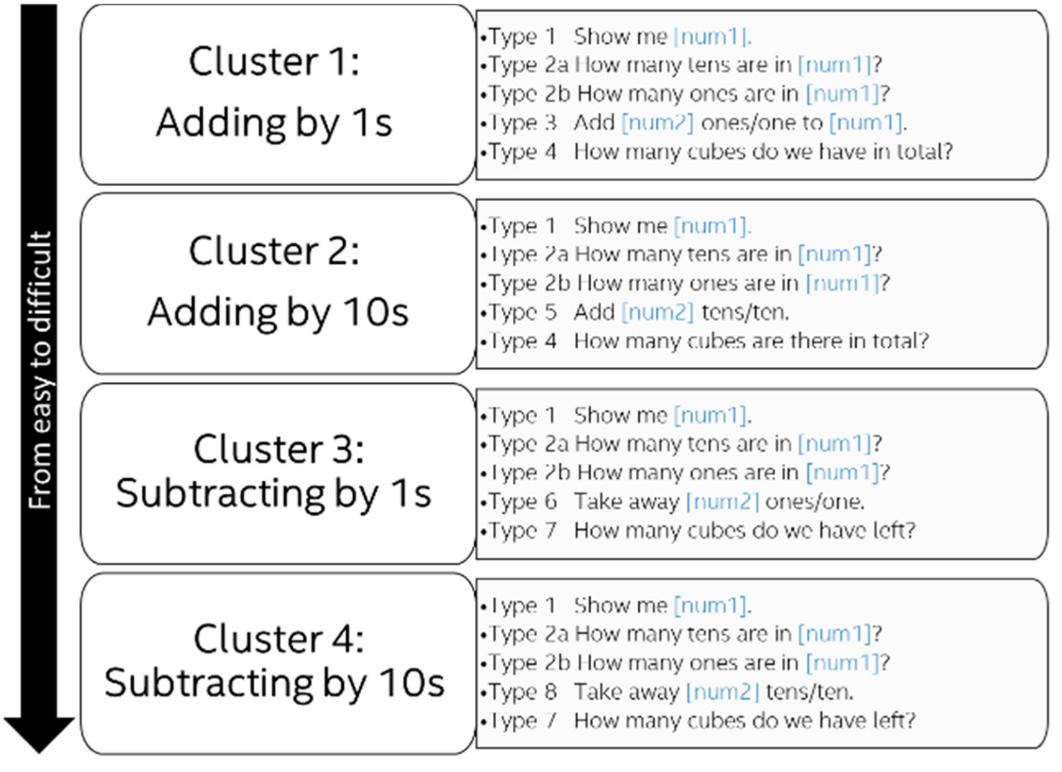

FIGURE 2 Question clusters and templates.

encourages the child to jump) and (4) content difficulty-based personalisation: Oscar understands the child's progress in real time and provides scaffolding as well as adjusts content difficulty if needed. As the first three personalisation policies are self-explanatory, we will describe the fourth one in detail in this section: There are three pillars to define content difficulty in Kid Space: (1) number range: range 1 (1–30), range 2 (31–50) and range 3 (51–100), (2) question clusters (from the easiest to the most difficult—cluster 1, 2, 3 and 4 as shown in Figure 2) and (3) randomised order of clusters. In the personalisation policy, each child starts at number range 1 and needs to get all questions right without using any scaffolding in one specific cluster to move to the next level (a level is a number range and cluster combination, see Figure 3). Once all number ranges and clusters are mastered (number range 3 + cluster 4), there is a challenge level with randomised order of clusters regardless of their difficulty in number range 3.

Experience definition

Kid Space learning experiences have five distinct sections: (1) meet and greet, (2) warm-up game, (3) training game, (4) learning game and (5) dance party (see Figure 4). The experience begins with a simple meet and greet between Oscar and the child followed by a warm-up game called red light green light (a.k.a. standing still (red light)/jumping (green light)). The warm-up game serves to build rapport between Oscar and the child as well as to nurture excitement for further gameplay. Next, the child completes the training game, where Oscar provides a problem scenario of having an empty garden and suggests planting flowers to address this problem. Oscar then introduces the child to the physical manipulatives: blocks (one cube representing ones) and sticks (10 connected cubes representing tens). After some basic maths questions using blocks (eg, 'show me five blocks', 'add three blocks'), Oscar directs the child's attention to his garden. Flowers begin to bloom in his garden as a reward for questions answered. Next, Oscar repeats this cycle with the sticks. During the training game, the solution to each problem is modelled by Oscar on the laptop screen for on-demand scaffolding (Winkler et al., 2020) to get the child ready for the actual learning game.

From easy to difficult

- **Level 1:** Number Range 1 + Cluster 1
- **Level 2:** Number Range 1 + Cluster 2
- **Level 3:** Number Range 1 + Cluster 3
- **Level 4:** Number Range 1 + Cluster 4
- **Level 5:** Number Range 2 + Cluster 1
- **Level 6:** Number Range 2 + Cluster 2
- **Level 7:** Number Range 2 + Cluster 3
- **Level 8:** Number Range 2 + Cluster 4
- **Level 9:** Number Range 3 + Cluster 1
- **Level 10:** Number Range 3 + Cluster 2
- **Level 11:** Number Range 3 + Cluster 3
- **Level 12:** Number Range 3 + Cluster 4
- **Level 13 (Challenge Level):** Number Range 3 + Randomized [Cluster 1, 2, 3, and 4]

FIGURE 3 Game levels.

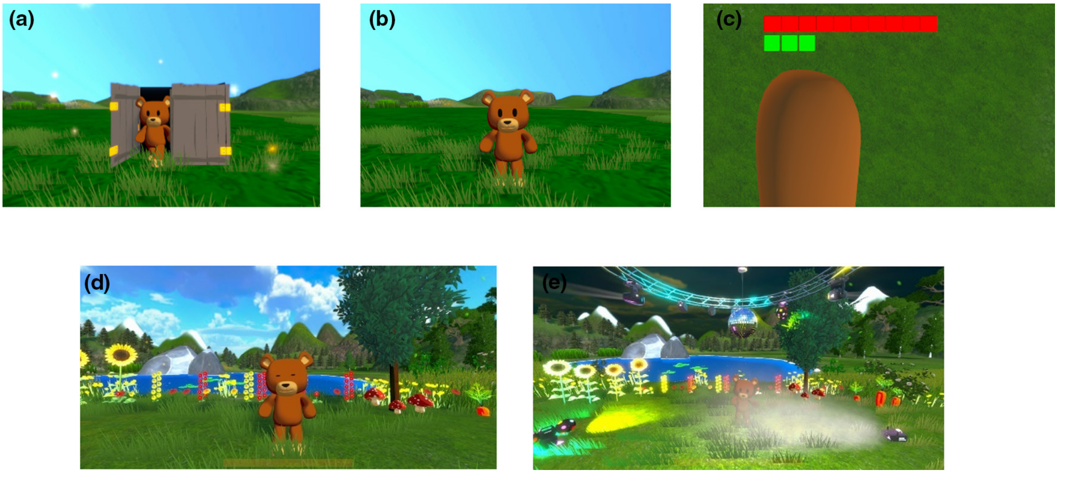

FIGURE 4 (a) Meet and greet, (b) warm-up game, (c) training game, (d) learning game and (e) dance party.

After the training, the child starts playing the actual learning game. During this game, when Oscar asks a question utilising 1s and 10s, the child is expected to make that number by 'showing or telling' Oscar (depending on the question type) the appropriate number of blocks and sticks. For example, if Oscar asks the child to show the number 27, the child should present Oscar with two sticks and seven blocks by placing them on the playmat. When the child correctly answers a maths question, an audible and visual feedback are provided. After five correct questions, visual elements (such as clouds, trees, rocks, etc.) are added to the garden scene as a reward—similar to the flowers blooming in the training game. During the entire experience, the child's parent is also present in case the child needs additional support (thus creating a form of human–AI collaboration (Ji et al., 2023)), such as when the child is still struggling with a question even after Oscar's scaffolding. After the learning game, Oscar and the child have a dance party to celebrate their success together.

METHODS

Research design and question

To understand how the system redesigned for home usages impact the parents' initial concerns about screen time, lack of social interactions and lack of physical activity, we conducted a user study with second-grade children[1] and their parents in their homes using a multi-method research design: (1) A quasi-experimental design with one group pre/post-test and (2) a formative research method (Reigeluth & An, 2009; Reigeluth & Frick, 1999) using an exploratory case study (Merriam, 1991; Yin, 1994) to understand environmental and social factors impacting user experiences. Utilising this research design, the current study aims to address one major research question: What was the impact of Kid Space on the parents' concerns after observing their children engaged with Kid Space in their homes?

Participants

To address the research question, we recruited 12 children (referred to as C1–C12) and their parents (referred to as P1–P12) through a purposeful sampling method (Fraenkel &

Wallen, 2008; Marshall, 1996). An online recruitment tool was first used to send initial invitations to potential candidates for participating in the study with a brief study description and consent form template. These invitations were sent to ~150 users of the tool who were living in Portland, Oregon in the United States (co-located with the study team for ease of execution). 19 candidates signed up to get involved in the study. Among these participants, 12 were selected since they met the following recruitment criteria of the study: All children were in the second grade with the distribution balanced in terms of gender, belonged to a diverse set of schools (eg, homeschool, public and private schools) and had prior knowledge of 1s and 10s in maths (as validated by our knowledge test prior to the study). All children were English-language proficient and had previously used a laptop for learning purposes (eg, playing educational games). All parents had basic technical skills (eg, attending an online meeting) with reliable Internet connectivity and enough physical space in their homes to accommodate the Kid Space physical setup. All parents were informed about the study procedures and signed an informed consent form before participating in the study with their children.

Procedure

Learning sessions took place in children's homes under their parents' supervision, based on their scheduling convenience. On the day of the session, one research team member did the contactless delivery of the setup (out-of-the-box experience; see Figure 5) to each children's house along with other research materials and instructions. After a parent received the materials, a remote research team member (ie, known as the facilitator) connected with the parent through an online video conferencing tool to aid in setting up the system. Using the setup guide that we had developed, the parent prepared the hardware and software while the facilitator stayed on the conference call to address any questions (see Figure 6 for a schematic overview of research execution).

Once the setup was completed and remotely validated, the facilitator collected baseline metrics from the parents through a semi-structured interview (see the Appendix for the interview protocol). The interview included several questions about child profile, parent profile, overall perceptions about technology in education and concerns for technology use by their young children. As a part of this interview, to understand the parents' initial concerns (prior to experiencing Kid Space), the facilitator provided a simple scenario to contextualise their baseline concerns: '*Now, let's imagine that I developed a perfect educational game for your child. Your child will play this game on her laptop to study maths at home on her own when she comes back from the school. The game is very well-designed, and it could substantially help your child learn maths concepts at home*'. After introducing the scenario, the facilitator asked the parent to rate their level of concerns about screen time, lack of physical activity and lack of social interactions in separate questions along with their reasoning for each of these ratings (eg, '*On a scale 1-5, could you rate how much you would be concerned about … [screen time/lack of physical activity/lack of social interactions] for your child while playing the game: 1 is "Not Concerned at All", 5 is "Very Concerned"? Why?*'). After completing the interview, the facilitator conducted a short training based on the study protocol to get the parent ready to supervise the learning session. Next, the parent brought the child to the learning space (see Figure 7) and asked the child for any basic needs (tiredness, hunger, room temperature, need for the bathroom, etc.) and addressed them if necessary. The parent also asked how the child was feeling and why prior to the start of the session (see the Appendix for the interview protocol). Finally, the parent walked their child through a training protocol to familiarise them with Kid Space setup.

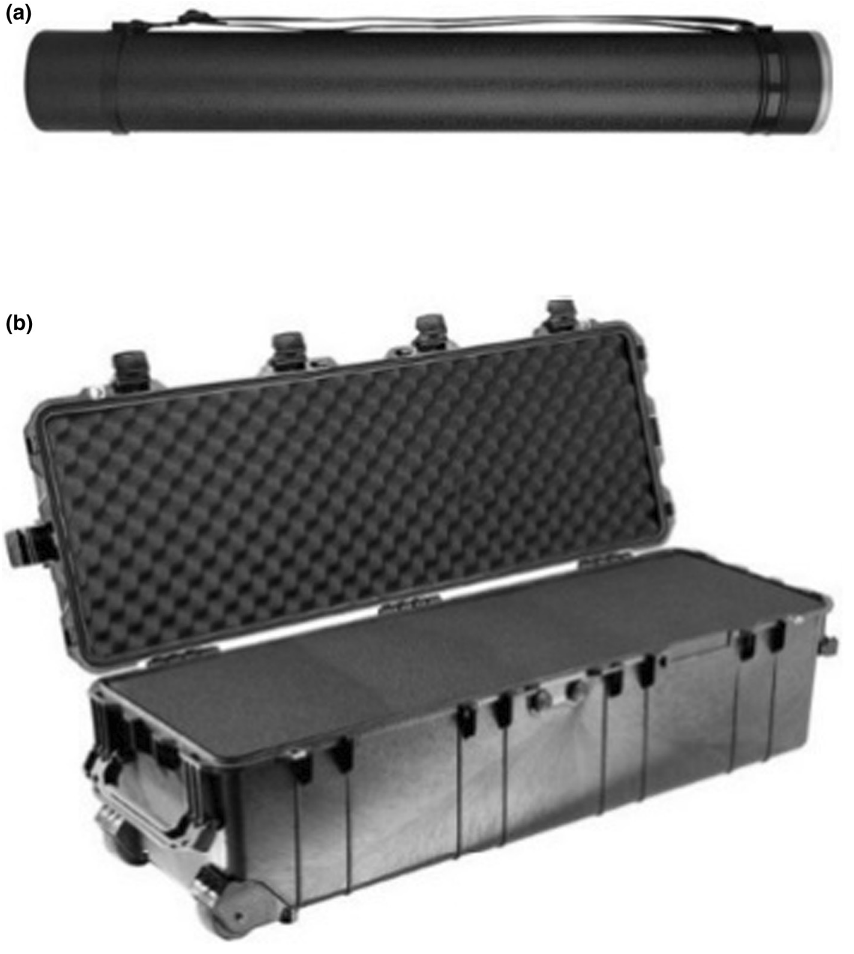

FIGURE 5 Out-of-the-box experience: (a) mobile play mat storage and (b) hardware storage.

The child's experience was structured in two consecutive sessions (see Figure 8 for an overview of the learning sessions). In session 1, the child experienced meet and greet, warm-up game and training game sections of the experience. There was a short break between sessions 1 and 2. In session 2, the child played the actual learning game followed by Oscar inviting the child to engage in a dance party. After finishing both sessions, the parent conducted a semi-structured interview with the child and collected post-session experience metrics (see the Appendix for the interview protocol). These metrics included how the child felt while playing with Oscar and why, whether the child wanted to play with Oscar again, the things that excited them the most and the things that they disliked. Once the child left the learning space, the facilitator then did a post-session interview with the parent by contextualising the questions around Kid Space this time (see the Appendix for the interview protocol). As a part of this interview, the facilitator also collected post-session concern levels after experiencing Kid Space: '*Now, let's imagine that I will leave Kid Space setup and game with you so that your child keeps studying maths at home on her own when she comes back from the school. On a scale 1-5, could you rate how much you would be concerned about … [screen time/lack of physical activity/lack of social interactions] for your child while playing the game with Oscar: 1 is "Not Concerned at All", 5 is "Very Concerned"? Why?*'

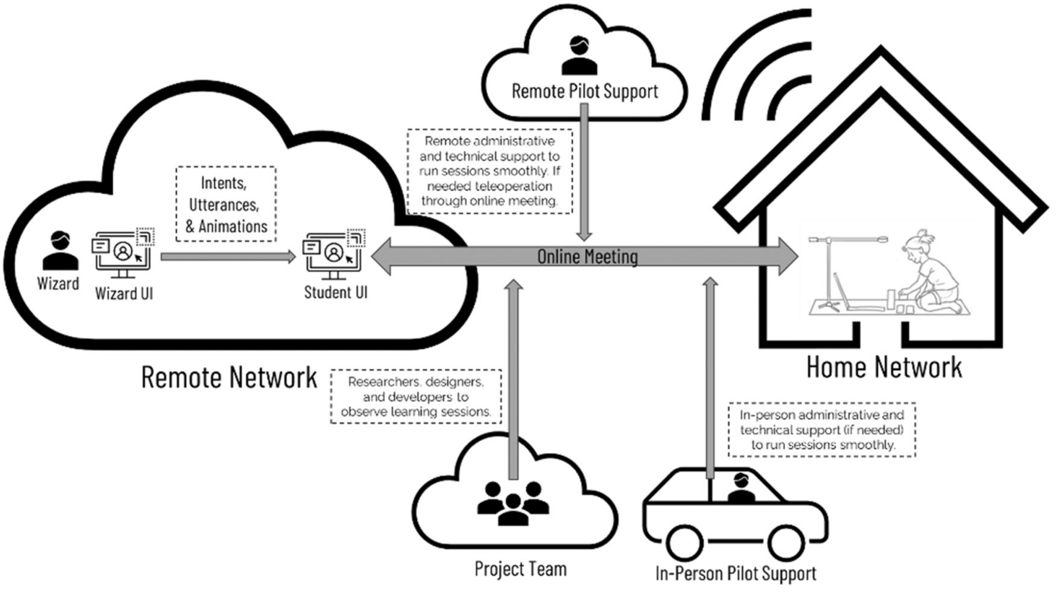

FIGURE 6 Schematic overview of research execution.

FIGURE 7 Sample views from the learning sessions.

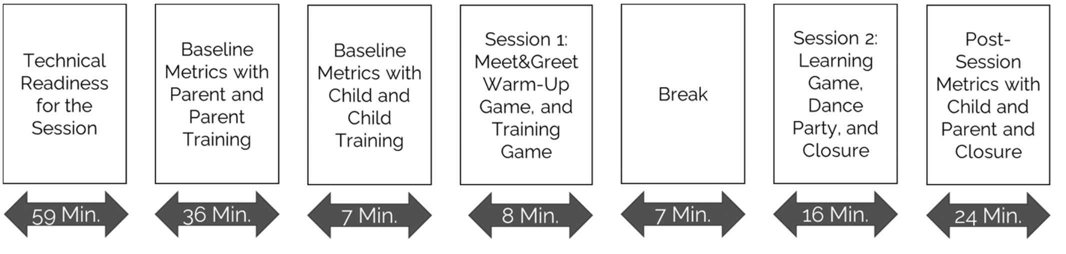

FIGURE 8 Overview of the learning sessions along with average durations for each section.

During the sessions, the researchers, designers and developers in the research team conducted online observations in the background for generating insights to improve experiences for future iterations, while a human wizard (from the research team) controlled Oscar's utterances and actions using a remote Wizard-Of-Oz setup. The wizard observed the children's activities and listened to their speech via a video-conferencing system (see Figure 6). We custom-built a wizard interface to enable the wizard to control the user interfaces (UIs) based on the game flow and provide relevant responses through Oscar. Eventually, our goal is to have an AI-driven automated system. However, for this first study, we utilised a Wizard-Of-Oz setup to collect authentic data for fine-tuning the AI algorithms and game logic prior to future real-world pilot deployments. For more details about the wizard interface, refer to Aslan, Agrawal, et al. (2022).

Data collection and analysis

For data collection, we utilised multiple sources to address the study's research question. The multi-modal data collected during the learning sessions included videos from the depth camera and built-in laptop camera, audio from the built-in-microphone, wizard dashboard video and logs, user interaction logs and other user research data including the interview data from the parents and the children before and after the sessions. For data analysis, we first prepared the quantitative data for pre-post evaluations of the parents' concerns to conduct statistical analyses. We also transcribed the interviews verbatim and analysed the data using content analysis (Krippendorff, 2004; Weber, 1990).

To triangulate these results with learner engagement findings, we employed expert coders with student-data annotation background to label the multi-modal data (eg, children's audio and video). We followed the labelling protocol by Aslan et al. (2017) for the expert coders to annotate the data for different pillars of learner engagement: (1) task-engagement (whether the learner is on-task or not), (2) focus of attention (where the learner is looking), (3) physical activity (whether the learner is physically active or stationary) and (4) social interaction (whether the learner is verbally or non-verbally interacting with the virtual agent, or not). For more details about operational definitions of these labels, see Aslan, Agrawal, et al. (2022).

Using these annotations, we first investigated coder variations by computing inter-rater reliability (IRR). Since coders were asked to identify start and end of each label rather than providing only labels to predefined-sized video segments, alignment of those multiple annotations was necessary. Therefore, each coder's label set was divided into 2-seconds windows with 1-second overlaps to obtain coder-specific window-based annotations (Aslan, Agrawal, et al., 2022). For each window, the dominant label was assigned. Using these coder-specific window-based annotations, IRR was computed using Gwet's First Order Agreement Coefficient (AC1) (Gwet, 2014). IRR analysis indicated that the agreement among different coders was high (0.892). The final annotations were obtained by applying majority voting to each of the windows.

Internal validity, reliability and external validity

For ensuring internal validity (trust value) and reliability (consistency), we utilised the triangulation method through mixed-method data collection and analysis from multiple sources and multiple participants as advised by Merriam (1991). We provided thick and rich descriptions of the findings (with both parents' and children's perspectives) and included enough details about the participants' profiles to help readers understand the typicality of the sample involved in the study. This could help readers to evaluate external validity (transferability) of the results to other cases, as indicated by Merriam (1991).

FINDINGS

The analysis of the interview data showed that the parents rated Kid Space as positive in terms of providing engaging content with less screen time, more physical activities and more social interactions—especially when compared to traditional computer-based educational games. For instance, P1 stated the following in the interview to explain how Oscar helped C1 to stay on-task: '*… She … like[s] … [Kid Space]. Every time when Oscar asked her to do something, she's … focused and try to do what Oscar asked her to do*' (P1, Parent Interview). Similarly, P7 also highlighted the role of verbal interactions between the child and Oscar that helped staying engaged: '*… Once he [C7] realized that he could ask Oscar the questions … that kept him engaged too, I think more than … the game where he clicks around and he just seems more engaged in this [Kid Space] than he has with any other [games]*' (P7, Parent Interview).

In addition to the perceived benefits for engagement, the interviews also revealed how the parents' concerns about screen time, lack of physical activity and lack of social interactions were alleviated after experiencing Kid Space. For instance, in her interview before experiencing Kid Space, P12 was very concerned about the lack of social interactions when her child is engaged with technologies—even for learning. However, after experiencing Kid Space, when asked about her concerns related to lack of social interactions, she pointed out the socially engaging role of Oscar as an authentic peer learner in the physical space and stated the following: '*I know I answered this question differently earlier [before experiencing Kid Space], but now after observing, I'd say I am definitely less concerned [about lack of social interactions] … [The] reason … is Oscar was very engaging… was fairly real…*' (P12, Parent Interview). In the interview, P9 also highlighted the role of Oscar as a social peer learner with verbal skills: '*I think she really liked … [Kid Space]. I think she enjoyed the interaction. She's an only child so any interaction—that's great … She … [was] socially interacting with Oscar … When she does other computer games that there's no speaking, … it's just her playing … [the] game. But this one is … they're interacting*' (P9, Parent Interview). Similarly, P3 indicated the social role Oscar played in the experiences and highlighted the importance of personalisation during the interactions: '*I can do this with him [C3] too on my own because we have manipulatives too that I work with him …, but this is fun. I think it's … definitely more interactive because it's not mom, it's someone else and it's someone that knows his name. I think that's good that you … have that personalisation built in*' (P3, Parent Interview).

In their interviews, the parents also reflected on their concerns about screen time before and after experiencing Kid Space. Before experiencing Kid Space, P9 shared concerns about screen time and pointed out that extended screen time could trigger health problems: '*I know she's learning, but I don't want it to be so long that … [it] causes eyestrain or anything like that*' (P9, Parent Interview). However, after experiencing Kid Space, P9 indicated that '*[I am] not concerned [about screen time anymore] because … it was very interactive that she was using [physical] blocks*' (P9, Parent Interview). In other words, utilisation of physical elements in the experience impacted P9's perception of screen time significantly. In the interview, P8 explained the differences between Kid Space and other digital educational games in terms of screen time as follows: '*[With Kid Space] … it's not [a] zombie mode and he [C8] turns into actually talking and engaging … You can see on his face, it's very different from when he's playing a video game and he's just zoned out or even when he was playing with [the educational game on his tablet] and … you could just wave your hand in front of his* *face, and he's just like glued to the screen, … [Kid Space] was very different*' (P8, Parent Interview).

In addition to the perceived benefits on social interactions and screen time, in their interviews, the parents also highlighted how Kid Space encouraged the children to become more physically active during learning. P5 acknowledged the physical aspect of Kid Space in the interview as follows: '*It's more physical than [a traditional PC-based game] … [especially] jumping at the start [during the warm-up game], there was much more movement*' (P5, Parent Interview). Similarly, P10 also described the value of physical activity in Kid Space as: '*I liked how he was asked to move with the character [Oscar] … and he didn't have to … be so stationary. You can see … [that] he likes to move … and [he] like[s] actual jumping [during the warm-up game] and body movement*' (P10, Parent Interview).

These qualitative insights are also supported by the quantitative findings on the parents' ratings of concerns before and after experiencing Kid Space. To compare the parents' before and after evaluations, we conducted a paired *t*-test and computed Cohen's *d* to measure the effect size. We analysed (1) the parents' pre-ratings of their concerns (before experiencing Kid Space) on screen time, lack of physical activity and lack of social interactions when their children were engaged with a hypothetical traditional computer-based educational game and (2) their post-ratings of these concerns (after experiencing Kid Space). Figure 9 shows the average pre- and post-concern levels (in range [0, 1]), detailed results (including *t* statistic, *p* value and *d* effect size), along with significant changes marked with asterisks. These results indicate that the parents reported feeling significantly less concerned ($p<0.1$) after experiencing Kid Space: The parents were significantly less concerned about screen time ($M=0.19$, $SD=0.24$), physical activity ($M=0.23$, $SD=0.27$) and social interaction ($M=0.21$, $SD=0.23$) after experiencing Kid Space compared to their initial concern levels (screen time: $M=0.48$, $SD=0.36$, $t(11)=2.59$, $p=0.041$, $d=0.67$; physical activity: $M=0.42$, $SD=0.34$, $t(11)=2.14$, $p=0.056$, $d=0.62$; social interaction: $M=0.42$, $SD=0.46$, $t(11)=2.59$, $p=0.025$,

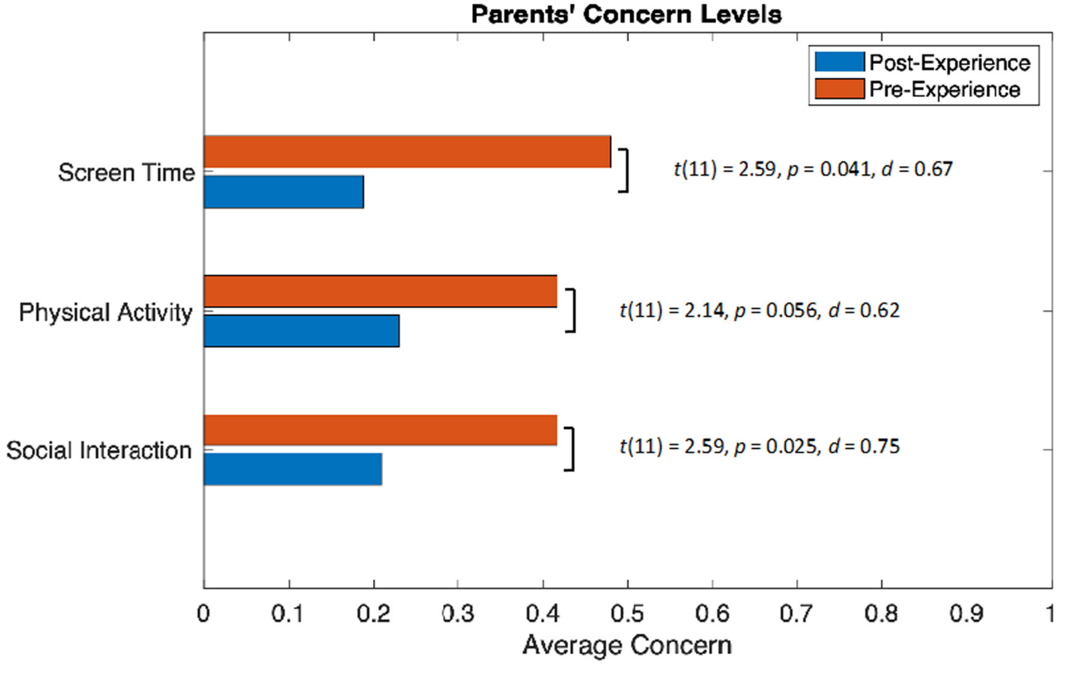

FIGURE 9 Summary of parents' pre- and post-experience concerns (concern levels range in [0, 1], and all changes are significant with $p<0.1$).

$d=0.75$). As these results summarised in Figure 9 indicate, all effect sizes (ranging from 0.62 to 0.75) exceeded Cohen's convention (Cohen, 1988) for a medium effect size ($d=0.5$).

To triangulate these critical perception changes of the parents with observational data outlining what actually happened during the sessions that could result in these perception changes, we used the labelled data for (1) task-engagement, (2) focus of attention, (3) physical activity and (4) social interaction. The distributions for different sections as well as the overall experience are provided in Figure 10: For task engagement, the children were always on-task during the learning experiences. They demonstrated unexpected behaviours 7.1% of the time despite of being still on task such as showing numbers with their fingers instead of using physical manipulatives or glancing at their parents while still engaging with the experience. In terms of focus of attention, the children were focused on the laptop screen 48.5% of the time, whereas for the remaining 51.5% of the time, the focus of attention was on the physical aspects of the experiences (with 28.8% of the time focused on the physical manipulatives). In terms of physical activity, the children were physically active (from manipulating the blocks to jumping) 92.0% of the time on average. They got more active as they advanced through the experiences: meet and greet (82.8%)—the lowest; dance party (97.7%)—the highest. For social interaction, the findings show that the children were predominantly engaged with Oscar (84.3% of the time) mostly through non-verbal interactions (69.4% of the time).

In addition to these observational findings from the labelled data, we also investigated the children's self-reports during pre-post interviews to further triangulate the results from their perspectives. Before and after each learning session, we asked the children to express how they felt (ie, unhappy, I do not know, fine, or happy) and why. Majority of the children reported that they were either fine or happy before the learning sessions. After the sessions, 10 of 12 children reported that they felt happy and one of them reported fine while playing with Oscar. Only one child (C11) indicated that he felt unhappy because he found the content too easy for him (see Table 1 for a summary of the children's quotes). At the end of the sessions, we also asked the children if they were willing to come back to play with Oscar again: All children except for C11 wanted to play with Oscar again (see Table 2 for a summary of the children's quotes). The quotes from the children showed that they particularly liked the following aspects about Kid Space: (1) Oscar's pedagogical support when they

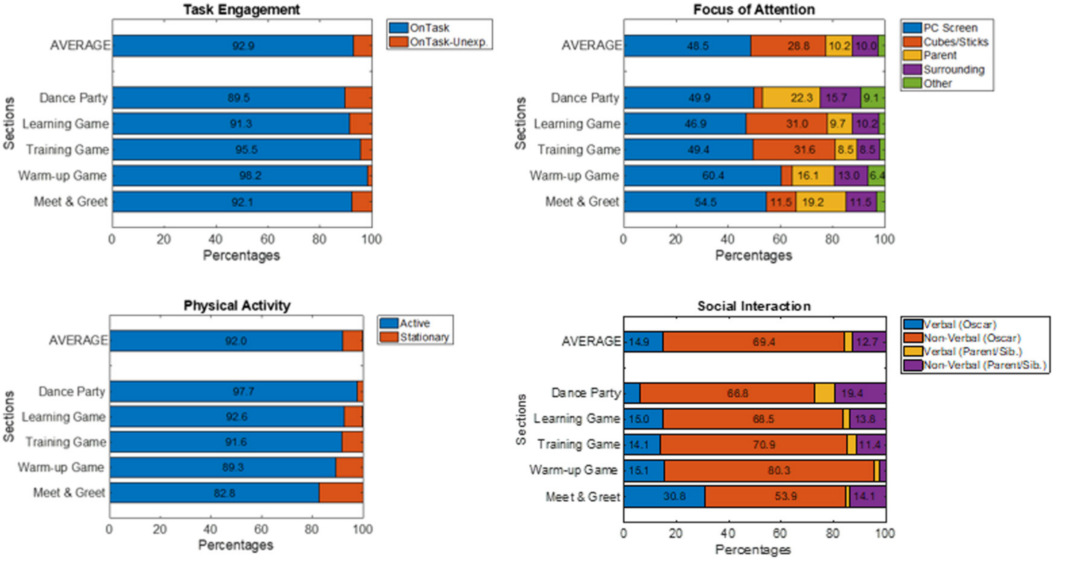

FIGURE 10 Distributions of session data.

TABLE 1 Children's quotes of their reasoning for how they felt during Kid Space.

C1: 'Because Oscar is very cute. [Oscar] make[s] something new in the garden and when I got stuck, [Oscar] helps me'	C7: 'First, I made a new friend, and I would like to play more with [Oscar]'
C2: 'Oscar is fun!'	C8: '[Oscar] is very kind … very fun to play with'
C3: 'I like doing maths and I also like playing video games and I like doing them at the same time'	C9: '[I] was having lots of fun! [Oscar] is cute!'
C4: '[Oscar] can talk and … was fun to play with'	C10: 'Because I like math, especially online maths games'
C5: 'It was easy. I think Oscar is good'	C11: 'The maths was easy'
C6: 'I had fun playing with Oscar'	C12: 'Really fun and cute animation. … [I] would like to add more garden features [to] Oscar's garden'

TABLE 2 Children's quotes of their reasoning for willingness to come back.

C1: 'I want to ask Oscar questions. Oscar is fun'	C7: 'We are both learning new things. We are subtracting and adding'
C2: 'I like that [Oscar] is a bear and I want to help [Oscar] build his garden'	C8: '… [I] love Oscar, Oscar makes me feel so smart'
C3: 'Doing math'	C9: 'Solving maths problems'
C4: 'When [Oscar] asks to show a number putting the cubes down'	C10: 'The maths game I was just playing'
C5: 'The garden part was pretty nice. Mountains appeared and a lake'	C11: 'Because the maths game was too easy'
C6: 'Adding blocks'	C12: 'Plant veggies with Oscar. Can we get this game?'

were struggling, (2) Oscar's fun, kind and friendly character, (3) Oscar's cute appearance, (4) practicing maths while playing a game, (5) gamification elements (eg, shared goal, rewards, etc.) and (6) engaging with physical manipulatives. On the contrary, C11 did not find the difficulty level of content matching his ability level.

DISCUSSION AND CONCLUSIONS

Kid Space was created as a response to the findings of our previous ethnographic research with the parents of young children: The parents acknowledged the benefits of technology use for their children's learning, but still worried about extended screen time, lack of physical activity and lack of social interactions (Anderson et al., 2015; see also Ahearne et al., 2016; American Academy of Pediatrics, 2016; Blackwell et al., 2014; Wood et al., 2008). Therefore, it was important for us to address these concerns by implementing appropriate design features in Kid Space and validate the impact of these features in real-world tests with key stakeholders. To this end, the current study confirmed that after experiencing Kid Space with their children, the parents reported feeling significantly less concerned across all these areas—especially when compared to traditional computer-based educational games. More importantly, in their interviews, they clearly articulated the reasons why their perceptions changed after experiencing Kid Space. To summarise their articulations: Kid Space promoted children's (1) learning engagement by creating a personal connection between the child and Oscar and proving both verbal and non-verbal interactivity during the experiences, (2) social interactions by facilitating the perception of authentic conversational peer learner in the physical space with personalisation capabilities (including learning, remembering and using the children's first names during interactions), (3) distributed attention between digital and physical spaces to minimise screen time through utilisation of physical learning blocks and (4) physical activity by encouraging the children move together with Oscar especially during the warm-up game.

Supporting the significant perception changes of the parents, the analysis on the study data also showed that using Kid Space was a highly engaging experience for the children. This is an important finding as we know from the literature that children at this age group tend to have relatively lower attention span and it is a big challenge to keep them engaged (Shin, 2006). The children particularly liked (1) Oscar's character and appearance as well as Oscar's pedagogical support when they struggled, (2) gaming and gamification elements and (3) utilisation of physical manipulatives. The high levels of the children's engagement results came together with less screen time, more social interactions and more physical activities. In contrast, traditional computer-based educational game scenarios tend to require that children stay sedentary and stare at the screen without much physical or social interactions (Aslan et al., 2019; Mayer, 2014; Plass et al., 2019). It is important to note that the promising engagement results from the current study are very much aligned with the previous research we did with the Kid Space school prototype, in which we utilised an extensive set of sensors and visual immersion through human-scale projected content (Aslan, Agrawal, et al., 2022). Related research suggests that such visual immersion could provide potential educational benefits (Hamari et al., 2014). Being able to achieve similar educational outcomes with the Kid Space redesigned for home usages—despite the absence of such immersion—is promising because of less instrumentation requirements that in turn enables scalability and accessibility of these technologies in the future.

In addition to the key findings we outlined in the paper, the study data also helped us to extract key potential areas for improvement—or design features—for Kid Space and other similar pedagogical conversational systems developed for children's home usages. In summary, these included: (1) easier setup and usage with optimised setup size addressing diverse space limitations at homes, (2) minimised latency between Oscar and child interactions (eg, adding multimodal dialogue system to reduce the need for a human wizard), (3) more advanced personalisation, social (including more verbal interactions) and pedagogical skills for Oscar with increased contextual awareness (eg, sending children's engagement), (4) scalability and higher visual quality of content with diverse games and learning outcomes, (5) parental control features over Kid Space platform and Oscar (eg, time limit, content, etc.) and (6) accessibility features (eg, captions turned on for multilingual children) and support for neurodiversity.

Incorporating the areas for improvement, future research is needed to conduct more longitudinal studies with a larger sample size to validate the educational value of Kid Space in the long run. In terms of media comparison research, future work is needed to empirically evaluate the effectiveness of Kid Space as compared to conventional media, such as traditional computer-based educational games. In terms of value-added research, future work is needed to determine which features of Kid Space cause optimal learning for various types of learners. Finally, our aim is to enhance this first home prototype, where we utilised a Wizard-Of-Oz system running based on human intelligence only. As a future direction, we plan to develop and test the next iteration of this prototype featuring human-AI collaboration (Ji et al., 2023) where human intelligence will collaborate with AI to drive the system intelligence (Oscar) together.

LIMITATIONS

As in all studies, this study has limitations. First, since the children were involved in Kid Space learning sessions for only 1 day, a novelty effect (Hamari et al., 2014) could have an impact. In addition, the mere-exposure effect could come into play because the child is repeatedly exposed to Oscar, the teddy bear, which could lead to positive affect (Zajonc, 1980): Based on theories of emotional design, the appealing features of a teddy bear could also induce positive affect (Plass & Hovey, 2022). We tried to address these issues by involving qualitative insights from the stakeholders to further understand why they found Kid Space more desirable than traditional computer-based games. To this end, the parents and the children clearly articulated the key differentiations they perceived in their interviews, as outlined in the results. To further address this limitation, there is still a need for more longitudinal studies to assess the level of sustained positive perceptions and engagement with Kid Space. Second, the number of participants involved in the study was limited to 12 children and their parents. Although we obtained significant changes in the parents' concerns, there is still need for studies to validate these findings with larger set of subjects. Third, due to the time of the year for this study, we had to recruit second graders as the first graders would not be ready to utilise Kid Space content yet. This sample selection resulted in some undesirable outcomes including negative perceptions from one of the children and his parent as the content was not perceived challenging enough and visual content including Oscar as a character was found more suitable for younger children, not a second grader. Finally, the Wizard-of-Oz approach implemented in the study could have impacted the users' perceptions significantly: A fast and accurate recognition of the linguistic and visual inputs could have made the system appear more human than technically feasible. There is a need to validate the study findings with a future prototype featuring human-AI collaboration.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest. All authors are either employees or research consultants of Intel Labs.

DATA AVAILABILITY STATEMENT

Per consent forms signed by the participants, we do not provide open data access to the study dataset to protect personally identifiable information of the participants due to vulnerability of minor participants. All data are stored in encrypted devices (with anonymised file names) with relevant access controls regulated by the study team only, as approved by Intel Legal and Privacy department.

ETHICS STATEMENT

Prior to the study, the researchers got approval on an extensive privacy plan which also included approved consent forms for human subjects from Intel Legal and Privacy department.

CONSENT TO PARTICIPATE

Informed consent (including parental consent) was obtained from all individual participants included in the study.

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ENDNOTE

[1] We recruited 2nd graders rather than 1st graders because the 1st graders would not be ready to engage in this content as it was not fully covered in their school curriculum yet.

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APPENDIX
PARENT INTERVIEW: SEMI-STRUCTURED PROTOCOL SAMPLE

Before session protocol

Hypothetical scenario

Now, let's imagine that I developed a perfect educational game for your child. Your child will play this game on his/her laptop to study math at home on his/her own when s/he comes back from school. The game is very well-designed and it could substantially help your child learn math concepts at home.

1. On a scale 1–5, could you please rate how much engaged (ie, on-task) your child would be while playing the game on his/her own: 1 is “Not Engaged at All”, 5 is “Very Engaged”? Why?
2. On a scale 1–5, could you please rate what emotions would your child experience while playing the game: 1 “Very Negative Emotions” (eg, boredom, confusion), 5 is “Very Positive Emotions” (eg, excitement, satisfaction)? Why?
3. On a scale 1–5, could you please rate how much you would be concerned about screen time for your child while playing the game: 1 is “Not Concerned at All”, 5 is “Very Concerned”? Why?
4. On a scale 1–5, could you please rate how much you would be concerned about lack of physical activity for your child while playing the game: 1 is “Not Concerned at All”, 5 is “Very Concerned”? Why?
5. On a scale 1–5, could you please rate how much you would be concerned about your child becoming isolated (ie, lack of social interactions) while playing the game: 1 is “Not Concerned at All, 5 is “Very Concerned”? Why?
6. Are there any other things that you would concern you around your child playing this game? Why?

After session protocol

7. So, you and your child have just experienced Kid Space. How much did you like Kid Space on a scale 1–5, 1 is Dislike and 5 is Very Much? Why? What do you like or what do you dislike about Kid Space? What are your major concerns, if any?
8. How much did you like Oscar on a scale 1–5, 1 is Dislike and 5 is Very Much? Why? What do you like or what do you dislike about Oscar? What are your major concerns, if any?

Hypothetical scenario

Now, let's imagine that I will leave this setup and game with you so that your child keeps studying math at home on his/her own when s/he comes back from school.

9. On a scale 1–5, could you please rate how much engaged (ie, on-task) your child would be while playing the game on his/her own: 1 is “Not Engaged at All”, 5 is “Very Engaged”? Why?
10. On a scale 1–5, could you please rate how much you would be concerned about screen time for your child while playing the game: 1 is “Not Concerned at All”, 5 is “Very Concerned”? Why?
11. On a scale 1–5, could you please rate how much you would be concerned about level of physical activity for your child while playing the game: 1 is “Not Concerned at All”, 5 is “Very Concerned”? Why?
12. On a scale 1–5, could you please rate what emotions would your child experience while playing the game: 1 “Very Negative Emotions” (eg, boredom, confusion), 5 is “Very Positive Emotions” (eg, excitement, satisfaction)? Why?
13. On a scale 1–5, could you please rate how much you would be concerned about your child becoming isolated (ie, lack of social interactions) while playing the game: 1 is “Not Concerned at All, 5 is “Very Concerned”? Why?
14. On a scale 1–5, could you please rate how much would you be concerned about your child's privacy while playing the game: 1 is “Not Concerned at All”, 5 is “Very Concerned”? Why?
15. Are there any other things that you would concern you around your child playing this game? Why?

CHILD INTERVIEW: SEMI-STRUCTURED PROTOCOL SAMPLE (WITH SPECIFIC QUESTIONS UTILIZED IN THIS PAPER ONLY).

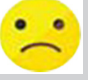
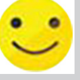
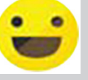
Before session protocol

Instructions

Please ask the following questions to your child and fill in the form accordingly before the session.

1. Are you hungry now? Yes/No *[Please, circle your child's answer.]*
2. Are you tired now? Yes/No *[Please, circle your child's answer.]*
3. Do you need to use the bathroom now? Yes/No *[Please, circle your child's answer.]*
4. Is the room too hot or too cold for you now? Yes/No *[Please, circle your child's answer.]*
5. How are you feeling now? Are you unhappy *[while showing the smiley face to your child for unhappy]*, are you fine *[while showing the smiley face to your child for fine]*, or are you happy *[while showing the smiley face for happy]*. If you do not know, you can say "I do not know".

[Please write an "X" on the form to represent your child's selected answer.]

	 **Unhappy**	 **Fine**	 **Happy**	 **I do not know**
Your child's answer *[Please mark 'X']*				

6. Please tell me what made you feel like that

[Please write a summary of your child's response below.]

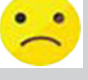
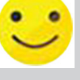
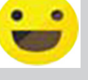
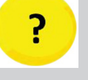
After session protocol

Instructions

Please ask the following questions to your child and fill in the form accordingly after the session.

7. How were you feeling while playing the game with Oscar today? Were you unhappy [while showing the smiley face to your child for unhappy], were you fine [while showing the smiley face to your child for fine], or were you happy [while showing the smiley face for happy]. If you do not know, you can say "I do not know".

[Please write an "X" on the form to represent your child's selected answer]

	 **Unhappy**	 **Fine**	 **Happy**	 **I do not know**
Your child's answer *[Please mark 'X']*				

8. Please tell me what made you feel like that.

   [Please write a summary of your child's response below.]

9. Do you want to play with Oscar again next time? Yes/No *[Please, circle your child's answer]*

[If yes] When you play again, what parts are you the most excited about playing with Oscar?

[Please write a summary of your child's response below.]
[If no] Can you explain me why you do not want to play with Oscar again?
[Please write a summary of your child's response below.]