Augmented Reality Family Interactions Study

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Abstract: WestEd conducted an exploratory mixed-methods study around the use of Augmented Reality (AR) technology in parent/child collaborative environments. The goal of the study was to identify when and how AR can encourage or inhibit productive learning interactions between parents and children. Most AR applications in existence have been developed for adults or older children; the developer is breaking new ground with this initiative to develop educational AR games for young children.

Research Questions

Augmented reality (AR) technology is increasingly being used in a wide variety of contexts, including in the context of learning and education. In augmented reality, a live camera feed of the real world is combined with digital images and text to create an enhanced and often interactive experience for the user. The overarching research questions guiding this work are:

1) Can AR be more effective than traditional or purely digital experiences in engaging parents?

2) Can AR be more effective than traditional or purely digital experiences in encouraging academically-oriented dialogue between parents and children during play?

Methods & Data Sources

This study focused on two AR games that were designed to help children learn about animal behaviors and habitats: *Going Batty* and *Mountain Rescue*. Both games target early elementary students (ages 6-8). *Going Batty* is a webcam-based AR game available online from PBS. It is a motion-based game, meaning that children perform physical actions that are captured by the webcam and then translated into actions within the game. *Mountain Rescue* is an AR game developed by Georgia Tech. It is a marker-based game, meaning that the camera in the mobile device used in the game recognizes printed or embedded images to trigger game actions.

Seven parent/child dyads were recruited for participation in the study. The dyads included 7 children (5 boys, 2 girls) and their parents (1 father, 6 mothers). All children participating in the study were between the ages of 6 and 8 years old (average age 7.6 years). Every parent/child dyad played both *Going Batty* and *Mountain Rescue*, one of which was in AR format and the other in non-AR format.

Family participation sessions were observed and, if the parents consented, audio recorded and video recorded. Session audio was transcribed and triangulated with observation fieldnotes. The observations focused on the user experience of the games, as well as engagement and interactions between parents and children. Researchers recorded minute-by-minute details about the stage of the game that the children were playing, the total length of play, and specific issues related to usability. They also recorded the mode of play (e.g., whether a child was playing alone or engaged with the parent), children's affect, the presence of help-seeking or helping behavior in the parent/child dyad, the presence of academically-oriented dialogue between the dyad and the presence of "scaffolding," a term coined by researchers to reference Vygotsky's (1978) notion of the role of more capable peers, parents, and others in contingently helping children's efforts to understand and learn. Children also took short pre-tests and post-tests aligned to the skills being taught in the parallel AR and non-AR games in order to collect preliminary evidence of what children may learn from playing the games.

Results

One of the most important findings of this study was the impact of AR on parents' ability to create a shared frame of reference (both child and parent able to look simultaneously at the same object) with their children, and thus on their ability to engage in effective scaffolding (the role of more capable peers, parents, and others in contingently helping children's efforts to understand and learn). We found that the AR games included in this study were not well designed for family interaction. There was no internal prompting that might involve the parents naturally in the AR gameplay. In the non-AR versions of the game, parents were able to share physical proximity with their chil-

dren and easily form a shared frame of reference. In contrast, establishing a shared frame of reference was more difficult in the AR versions of the games, particularly for *Mountain Rescue*.

In the AR version of *Mountain Rescue*, the children hold the iPad and walk around in order to reach different points on a poster where they can activate various markers. Although two of the parents in our study were able to establish a shared frame of reference with their child for the duration of the game, it took concentrated effort and was often physically awkward for them to follow their child around the room. The AR version of *Going Batty* also inhibited the establishment of a shared frame of reference, largely because of the amount of physical space needed to play the game—parents needed to stand more than an arm's length away from their child in order to give them enough space to complete the movements required by the game, and the child needed to stand sufficiently far from the computer in order for enough of their upper body to be captured by the camera.

Non-AR games were found to be more conducive to shared frame of reference because of the very nature of the games—the gameplay was confined to a screen that could be observed and manipulated by both child and parent at all times during the game. Conversely, during AR gameplay, effective shared frame of reference depended highly on the involvement and engagement of the parent (e.g., were they willing to stay close to their child as their child moved around the room with the device; were they willing to stay engaged in the child's gameplay even though they themselves were no longer able to see the screen). A child's successful progression through an AR game was positively correlated with the level of active engagement on the part of the parent.

Another finding of this study addresses whether scaffolding in both the AR and non-AR conditions is related to academically-oriented dialogue between parents and children during play, and student learning. The results of the study suggest that effective scaffolding by the parent during parent/child dyad interaction is associated with increased academically-oriented dialogue in the context of scaffolding, and children's pre-test to post-test gains in both conditions. Parent/child dyads with a shared frame of reference during gameplay more effectively promoted game progress on the part of the child than those dyads without. The shared frame of reference appeared to promote effective scaffolding on the part of the parent.

Overall, the findings suggest that AR games and interactives have the potential to create rich learning environments for parent/child dyads. A shared frame of reference is crucial for the creation of these environments. As AR evolves to be used on products, such as *Google Glass*, and other versatile devices, creating opportunities for a shared frame of reference should be more feasible.

Recommendations for Future Game Development

Given these findings, we have the following recommendations for designing high-quality AR-based educational games:

- Build games that enable the parent player to be a facilitator for the child and perform actions such as initiating tasks, evaluating the child player's performance, and judging the child player's readiness for next level.
- Giving parents a separate device that will mirror what the child sees.
- Facilitate parents' scaffolding by providing rich problem-solving tasks and ensuring that parents and children can create a shared frame of reference.

Significance

The research indicates that the presence of certain factors in AR gaming experiences will increase opportunities to learn during collaborative family gameplay. AR games that are able to create shared frames of reference during gameplay and promote effective scaffolding by parents may help children learn more effectively. Though more research on the educational impact of this emerging technology is necessary, AR gaming experiences show promise of being an effective and engaging way for children to learn new content.

References

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