

Chapter 1

Finding a Path Forward for Integrating Augmented Reality Into K–12 Classrooms: A Literature Review

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ABSTRACT

The potential of augmented reality (AR) as a transformational tool has long been touted in academic circles. However, in order for AR to attain this goal, we must seriously examine previous research to determine if we are on the right path. This study examined 87 AR research studies situated in K-12 environments to determine what grade levels were involved, where the research being done was what content areas were involved, what kinds of triggers were used, and what learning environments were created through the use of AR. This research found that the majority of studies were situated in elementary contexts in science and math. Diverse learning environments were found including inquiry, problem-based learning, visualization, and gamification. Based on these findings, suggestions were made for future research including more research on students creating AR experiences, broadening the grade levels and content areas that are involved, and aiming future AR projects at the transformational level of the SAMR model.

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INTRODUCTION

“Simply put, we believe augmented reality is going to change the way we use technology forever.” (Cook, 2019 as cited in Chmielewski, 2017)

The potential for augmented reality (AR) as a learning tool has been touted for decades. One of the earliest uses of AR in education was the heads-up display used in training the United States Air Force pilots in the 1990s. Reports from this project indicated that AR data overlays amplified human performance in real-world tasks (Rosenberg, 1992). Later studies also determined numerous benefits stemming from AR in education, including increasing student engagement in learning (O’Shea et al., 2009), developing the ability to see complex spatial relationships (Dünser et al., 2012), visualizing environments that are impractical in real life (Shelton & Hedley, 2002), safely recreating dangerous experiments (Wojciechowski & Cellary, 2013), and amplifying story development in narrative books (Billinghurst et al., 2001).

Teachers have been intrigued by the possibilities of AR in education. Noting how AR provided opportunities in real estate, sales, and healthcare, teachers have been persuaded to explore potentials in overlaying real objects with virtual objects in the classroom (Prodromou, 2019). As constructivism is increasingly embraced in learning environments, teachers find that AR applications support the student-centered focus and experiential learning, both core tenets of constructivism.

Wang et al. (2017) asserted that AR technologies “allow learners the freedom to actively experience digital content and integrate new information into their existing knowledge base on an individualized path of discovery” (p. 1393). Further, over the last few years, the devices needed for AR technologies have become more affordable and ubiquitous, enabling more schools to provide one-on-one programs for their students (Carreon et al., 2019). Similarly, AR apps have also become more available. In some cases, specially designed books or soft foam cubes are the only AR targets needed (Green et al., 2019; Ntuli, 2019). However, AR has not fulfilled the promise of becoming a transformative technology in education (Cook, 2019). This may be due to teachers’ unfamiliarity with the technology or failure to see its utility in a sea of curricular demands.

Charting a path for AR in K-12 learning environments means understanding our past. As tools have improved and we have gained an understanding of AR in the classroom, researchers have reviewed historical AR literature and explored ways for AR to become a valuable educational tool (see Table 1).

There were many commonalities among the reviews in Table 1. Although they sampled literature from different sources, their findings were similar. Akçayır and Akçayır (2017) examined literature from a single source, the Social Sciences Citation Index, using the Web of Science as an entry point. Bacca-Acosta et al. (2014) searched for articles using the Google Scholar H5-index for the category “educational technology.” Hannel et al. (2015) and Yuliono et al., (2018) chose a traditional approach, using library databases like ScienceDirect, IEEE Xplore, and ProQuest.

In the four reviews, all authors eliminated theoretical discussions of AR or applications of AR that fell outside the study. The only articles included in all four reviews were studies that demonstrated a solid research design and implemented AR tools in education. The studies’ results intersected. Regardless of the construct named advantages, benefits, or promising roles, they all found that AR supported student achievement through motivation, engagement, and increased knowledge, and understanding of content. Additionally, all four found that AR promoted a student-centered learning environment.

The context of education was broadly defined in these reviews, including studies from both industry and higher education. While the reviews focused on learner outcomes, there was no clear understanding of the content areas supported with AR. K-12 education was defined as an area of interest in the studies;

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