Applying a Developmental Lens to Educational Game Designs for Preschoolers

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ABSTRACT

Preschool-aged learners process information differently from older individuals, making it critical to design digital educational games that are tailored to capitalize on young children’s learning capabilities. This in-depth literature synthesis connects features of digital educational game design - including visuals, feedback, scaffolding challenge, rewards, and physical interactions to how young children learn. Preschoolers’ interests and abilities (e.g., limited attention-span, early reading skills, etc.) are different than older users. As such, developmental science should be used to guide the design of educational games from aesthetic decisions that capture preschoolers’ initial interest (e.g., meaningful characters) to carefully select end-of-game rewards (e.g., leveling up). This article connects learning and developmental science research to the design of digital educational games, offering insights into how best to design games for young users and how to select developmentally appropriate games for children.

KEYWORDS
Developmental Abilities, Digital Games, Preschool Learning, Scaffolding Challenge

INTRODUCTION

Prior to formal schooling, young children often learn through devices in their homes (Plowman, McPake, & Stephen, 2010), which may explain why 58% of educational mobile games (apps) are made for preschool-aged users (Highfield & Goodwin, 2013; Shuler, 2012). Digital educational games (referred to here as educational games) for tablets, phones, and computers have been designed to teach a broad range of content (e.g., math, literacy, geography, etc.), creating a high market demand (Highfield & Goodwin, 2013) for use in home and school environments (Barab, Thomas, Dodge, Carteaux, & Tuzun, 2005; Tuzun et al., 2009), that will continue to grow in popularity (Plowman et al., 2012). Thus, designing educational games that harness preschoolers’ natural enjoyment of play (Samuelsson & Johansson, 2006) may create a highly useful medium for young children's learning.

Educational games use interactive platforms to fuse play with learning (Hirsh-Pasek, Zosh, Golinkoff, Gray, Robb, & Kaufman, 2015), building games’ capacity to increase users’ academic engagement, motivation, and knowledge (Annetta et al., 2009; Huizenga et al., 2009; Papastergiou, 2009; Tuzun et al., 2009; Wouters & Oostendorp, 2013). Yet, if digital games for young children are not designed with an understanding of how they develop and learn (Reich & Black, 2012), educators and caregivers could waste time, money, and resources on products that do not actually
teach children (Cuban, 2001; Rutherford et al., 2015). This qualitative review connects extant learning and developmental sciences research to game design to illuminate how educational game features could be designed to support 3-5-year-old learners.

Developing educational games for preschool-aged children can be particularly challenging since they process information differently than older individuals (e.g., shorter attention-spans, developing reading skills, etc.) (Hirsh-Pasek et al., 2015). However, since preschool learning is crucial for later educational success (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002) and research shows that it is desirable to interweave play with teaching (Gmitrova, Podhajecka & Gmitrova, 2009), educational games could be an ideal platform for teaching preschoolers. Yet, to be such, game designers must consider how young children typically learn by addressing age-specific interests, cognitive and physical abilities, and responsiveness to feedback and rewards. This review integrates key factors of early childhood learning research – cognitive, emotional, and physical – to inform how educational games could be designed to fit the developmental needs of preschool-aged learners. Though there are often individual differences in how children learn, research has identified teaching strategies that are typically effective for preschoolers in face-to-face settings and with digital technology. Importantly, researchers have previously explored how digital media have the capacity to connect to key factors of child learning (Chiasson & Gutwin, 2005; Cooper, 2005; Hirsh-Pasek et al., 2015; Kankaanranta et al., 2017; Lieberman, Bates, & So, 2009). This review extends prior research by merging these key strategies for teaching preschoolers and applying them to educational game design. The research question addressed is: How could applying a developmental lens to digital game design make educational games for preschoolers developmentally appropriate and truly educational?

**METHOD**

This review utilized two methods - an exploratory literature search and a structured literature review. This review was first inspired by previous research that explored the general benefits and challenges of combining childhood learning with educational technology. For example, Hirsh-Pasek and colleagues (2015) wrote a review applying science of learning research to the design of children’s educational apps, using four pillars from the science of learning - active learning, engagement, meaningful learning, and social interaction - as their framework. Such articles helped solidify the need for a qualitative review that specifically connects preschoolers’ unique learning processes with digital educational game design.

Thus, an exploratory search was conducted of studies on early childhood learning and digital educational games to see whether empirical research supported existing learning principles, specifically for preschoolers, and whether there were additional principles that needed to be accounted for. Literature searches were conducted through ERIC, PsycInfo, and Google Scholar, using the primary search terms: “early childhood”, “educational games”, “child development”, “preschool learning”, and “computer/tablet game design”. ERIC and PsycInfo were selected as our main engines since they were likely to contain published works emphasizing the educational and developmental perspectives of the target topic. A final Google Scholar search was also conducted to incorporate a wholistic scan of published work, including conference proceedings, across the general field. During these searches, empirical studies or review papers were selected if they met the criterion of having: 3-to 5-year-old target populations; learning through lab-settings, free play, or digital spaces; and game-based learning digitally or offline. To capture the broad range of literature published within this area, there was no publication year range specified for this exploratory search. After teasing out the studies that did not meet our criteria, there were over 200 articles left to critically examine for this qualitative review.

This pool of articles was read and content coded to identify themes using inductive and deductive procedures (Saldana, 2009). Codes were discussed by both authors and, when complete consensus was reached, were clustered around categories that included: 1) children’s developmental skills, 2) established teaching practices, and 3) design-based attributes in digital and physical games. These
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