Against Educational Games

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Emerging social and educational trends lead to an increase in the number of "educational" computer games available. These programs are touted for their benefits in making learning "easier, more efficient, and more motivating" (Schacter & Fagnano 1999). However, educational games fail to deliver on their promises for a multitude of reasons, not limited to the content of the games themselves.

Lack of Standards

One key issue for educational software use and development is the lack of standards for evaluation and creation of the software. Without standards, programs available to children vary in quality and usability. Lack of standards also impedes scientific research on the effects of educational games on student learning.

There are five major challenges for evaluation: defining the outcome, measuring the outcome, accounting for effects of the delivery medium, asking the wrong research questions, and practical problems (Schacter & Fagnano 1999).

Defining and measuring the outcome. While many studies point to the benefits of Computer Based Instruction (CBI) on student learning, these studies outline programs based on drill-practice models and simple tutorials. Most of these computer programs are based on behaviorist models of learning and do not account for the effects of immersive "microworlds[1]"

[1] Microworlds are a genre of CBI with an interactive interface composed of a collection of objects that model mathematical or physical properties. These environments can be manipulated in many ways and offer inherent challenges. *Angry Birds* is an entertainment example. Microworlds targeted for young children include *Sammy's Science House* and the *Pajama Sam* series.

programs based on constructivist principles. The results of these studies cannot be applied, as they have been, to all CBI and computer games (Schacter & Fagnano 1999; Rieber 1992).

Effects of the delivery medium. When comparing the effectiveness of CBI or computer games on student outcomes, studies do not account for the media itself. For example, consider studies comparing traditional teaching and instruction methods to self-guided use of a computer game. The instructional method and delivery method between both groups are different. Therefore, causality cannot be shown, since more that one variable has changed and extenuating variables have not been controlled for (technical problems, technological familiarity etc.). When accounting for differences in instruction, no compelling evidence that media improves learning has been found. In fact, the opposite may be true (Schleyer & Johnson 2003; Verhaegh, Fontijn, & Jacobs 2008).

Asking the wrong questions. Additionally, these studies ask the wrong questions. In his article "The Research We Should Be Doing," Dr. Charles Friedman[2] suggests that if the computer is exceptional, then using comparison groups and control groups in studies is inherently flawed; there is no comparison group. Any data collected on program use in education becomes invalid for one reason; computer programs are constantly in flux, especially during development. Any results collected from studies become obsolete due to the rapid change in the technology used (Friedman 1994).

Practical Problems in Production and Testing. Other problems also exist during the game testing and development period. Game developers manufacture products using virtual components. Many programmers design these components separately before being compiled into a cohesive project. For example an educational program may require virtual dice, random number generators, spinners, tables, graphs, and word processors. Educational game

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[2] Associate Editor *Perspectives on Computing and Medical Education*

components present a special problem; particular attention must be paid to their cognitive value. However, these components are designed primarily for learning, and not toward student development or collaboration. The codes for each component are fixed, thus the user cannot change the component within the game interface. This design type is not conducive to constructivism, which would dictate game components with a high degree of reusability for novel problems and manipulability (Roschelle, DiGiano, Koutlis, Repenning, Phillips, Jackiw, & Suthers 1999). In their article for *Computer*, senior cognitive scientist at SRI, Jeremy Roschelle, and his colleagues point out, "Developers lack the contact hours with students to directly create excellent educational software, and there are few signs that educators will ever become efficient producers of educational software" (Roschelle et. al. 1999). This begs the question, are "educational" games actually designed for classroom use?

Appropriateness For Age Groups

Game media is a relatively new concept and research on its effect on children is limited in comparison to studies on other screen media. Lieberman and colleagues suggest that insight can be found by studying children's consumption of non-game media. However, the authors assert, more research must be based on cognitive theory before the effectiveness of electronic games on learning can be illustrated. Games "provide a mix of media;"

> goal-orientations, interactivity, control over the action, feedback ... participation in the story, identification with the character one plays, social interaction with other characters, social recognition by peers and family for skill and achievement, and a "cool" factor that does not go unnoticed by the time children reach age 5 or 6 (Lieberman et. al. 2009).

Games are inherently entertaining; they demand children's rapt attention. Given the amount of time children spend with their electronic games, when considering the effects of educational games, it is also important to consider games labeled as "educational" designed for home and recreational use. These types of games include products for the V. Smile and Leapster hand-held devices and games on websites such as Playhouse Disney, Nick Jr., Nickelodeon, and Sesame Street (Lieberman et. al. 2009). Published materials for these products generally are not backed by research or educational standards. Little research exists on the effects of these games on cognitive, academic, or social development (Lieberman et. al. 2009).

While research suggests that well-developed games can provide positive interactive experiences, Lieberman and colleagues suggest poorly designed games can be "time-wasting sedentary activities that contribute little to children's learning, skill building, or healthy development" (Lieberman et. al. 2009). In this case, a warning should follow use of educational games: User be aware; games marketed for children may not produce the intended results. This warning may be particularly apt for games used outside the classroom.

Usability Issues

In their paper "On the benefits of tangible interfaces for educational games," Janneke Verhaegh and colleagues suggest that tangible, rather than virtual, environments promote children's learning. They note that while game challenge is necessary in promoting learning, educational games must be tailored to the player's ability. Furthermore, the game's challenge should not be due to usability issues (Verhaegh et. al. 2008).

Verhaegh and colleagues designed an experiment to study the ease of use of tangible and virtual learning games. 26 participants (age 5-7) were divided into two groups to play the Dutch block game "Passen en Meten"[3]. In one condition, participants played the wood block game. In the second group, children played a computerized version of the game developed by the

[3] a commercially available wood block puzzle game with colored blocks and assignment cards. The goal is to reproduce the pattern on the card (Verhaegh et. al.). This game is similar to Tangrams.

manufacturers of the physical version. All children were familiar with using a PC. Verhaegh and colleagues measured time to complete the puzzle and the number of measuring and fitting attempts (placing and rearranging blocks). Then, they interviewed the children after task completion.

Based on their interviews, 15 children found the virtual game to be more difficult, compared to 7 who thought the tangible version was harder. Although blocks in the virtual version were arranged and presorted for the user, children found difficulty in rotating the blocks to fit the objective pattern as well as switching to another color of block. Children especially had problems deciding which blocks had already been placed on the virtual board. It also took children significantly more time to complete the virtual puzzles. This suggests that the virtual interface was harder to understand and familiarize with. The tangible version was more accessible.

Additionally, more measuring and fitting trials were needed to compile the tangible puzzle. This suggests that the tangible version more effectively promoted trial and error exploratory learning. As this was the puzzle design goal, the tangible version was more effective in accomplishing the design intent.

One could also argue that tangible interfaces promote more social interaction and creative uses for game pieces. Consider the following observations made during the summer 2010 program at Girls Incorporated of Metro Denver.

> During free play, I watched a group of three first and second graders play “babies” with dominos. Each domino was a “baby,” and the girls worked to get all the “babies” across an imaginary river (a line of floor tiles) before an egg timer finished ticking. One girl distributed all of the dominos until each girl had an armful and they ran a relay race. If

> one "baby" was dropped, they lost their game. During their play, these girls were practicing their quantitative skills (dividing objects equally among peers). These skills are part of Jean Piaget's concrete-operational thought. During the concrete operational stage (Piaget's fourth stage of development) children begin to think more logically and are better able to perform spatial and quantitative tasks. During middle childhood, children are asked to perform increasingly complex spatial and reasoning tasks. Outside the classroom, these concrete operations are also incorporated into children's social and moral development. The first and second graders I observed believed that "fairness" was taking turns and equally distributing materials. Their invented game rules emphasized these concepts. When the game was fair, girls cooperated and completed a goal. The girls viewed their game as fun and regarded their playmates positively when play was fair. Positive peer regard, in turn will help develop Girls Inc. girls' sense of "industry" (Smith 2011).

Would these girls have played "babies" within the framework of a computerized game of dominoes—not if the game interface had been programmed to follow traditional dominoes game rules and did not allow for user reprograming (as suggested by Roschelle and colleagues).

Gender Biases

Digital technologies, namely computers, were thought of as the great equalizers in eliminating gender bias in education. In her 2006 meta-analysis of gender and the classroom, Karyn M. Plumm[4] proposes that technology in the classroom may, counter-intuitively, be reinforcing gender bias in education.

While students generally viewed computers in the classroom favorably, teacher attitudes about the role of computers in education play a large role in student successes and attitudes.

[4] Dept. of Psychology, University of North Dakota

Many attitudes surrounding use of technology may be unintentionally biased. Studies indicate that while most teachers also view technology favorably, the biggest obstacle for technology use in the classroom is teacher experience. In terms of gender attitude, more male teachers are familiar with technology than women and boys tend to have more prior experience with technology than their female counterparts (Plumm 2008).

Gender biases are especially inherent in video games. Most games developed during the 1990s were targeted to young men, based on marketing research on girls' interests (Kafai 2008). Additional studies show that males and females differ in their playing techniques and use of recreational digital games. Males are generally more confident in their ability to negotiate new technology and males are more engaged in games and technology than females. They also tend to play for longer periods than females.

This trend carries over into computer use. Male students more often used computers for recreation, whereas female students used them for "task completion" (e.g. writing papers and keeping track of information) (Lockheed 1985 in Plumm 2008).

Looking at computer use and recreational game design, it is apparent that if current educational games are modeled after recreational games, then boys will tend to have an advantage in a classroom that utilized educational software. Boys will tend to pay more attention to the game features and be more absorbed in the game. In this case, the exploratory nature of the game will likely help promote subject learning. But what about the other half of the class? It is likely that female students will be less skilled in performing the game tasks, navigating, advancing in levels, and competing. Additionally females may be less interested in the game, and thus less able to retain the information provided through the game environment. These stereotyped roles would then be reinforced by female teachers who may be less familiar with computer games an unskilled in guiding students through a virtual environment.

Role of the Teacher

A 2007 case study from the York University Institute for Research on Learning Technologies suggests that classroom use of educational games not only depends on the content of the game but on the classroom environment and classroom teacher as well, including his/her familiarity with and attitudes about technology. This study suggests that the burden of proof is not on the games, but on the teachers are their ability to use educational games effectively and teach digital literacy (Lotherington & Ronda 2007).

The researchers offer the case of Ms. Brown and Ms. Green from two school in the York Region School District in Toronto, Ontario, Canada. In both classrooms students were asked to design games and questions to reinforce material learned about geography and cartography in Canada. Students were presented a fictional story of an explorer traveling through different areas in Canada. They were then assigned to make games for other students across the country to learn about provinces using game shells modeled after children's board games (like Snakes and Ladders). In Ms. Green's classroom technology was "external" to regular practices. Ms. Brown's lessons were more technologically immersive. Ms. Brown programmed her lesson plan whereas Ms. Green wrote it out by hand. Ms. Brown introduced her lesson and demonstrated the game website. Students were then expected to post responses to prompts on the class website. Ms. Green's directions to opening the lesson website were handwritten on a blackboard in the computer lab. Students had "myriad" problems in following her instructions. In answering technological question Ms. Green displayed a high level of anxiety and continually admonished her students to be careful with expensive technology. According to this case study "When one child exclaimed: ‘I wish we could make the fonts bigger’, the teacher exhorted not to fiddle with the computer (Lotherington & Ronda 2007).

The researchers and both teachers noted that all of their students needed further instruction in digital literacy before the game could be beneficial to students. Many students, in both environments had problems with navigation or using secondary programs (such as spelling check). The researchers also suggest that future lessons involving games require the student to create fewer games. The original task was found to be overwhelming for students. Most notably, the researchers observed that boys were more enthusiastic and attentive to the lesson and more technology-focused. Also, students in the higher SES classroom who had talked more amongst peers about their recreational game use and favorite digital toys had much poorer academic familiarity with computers and digital literacy, indicating, according to the researchers, “that digital literacies are NOT something that can be left to recreational learning, as many would rationalize” (Lotherington & Ronda 2007).

Conclusion

Although educational software and games have been in development for over 20 years, this technology is still in its infancy, and should not be adapted for classroom use as of yet. Certainly, educational programs should not be used as a replacement for traditional teaching practices. Although these games are becoming ubiquitous, they still present problems with usability and many lack the robustness of “old fashioned” learning games such as puzzles and blocks, as suggested by Verhaegh and colleagues. Students and teachers cannot currently restructure and adapt published titles for their own lesson plans, and without regulations, the effectiveness of games labeled “educational” is questionable. Also, poorly designed games and lack of teacher support in technology use in the classroom may also be undoing years of gender equality strides in education. Finally, teachers must also be held accountable when introducing educational games, as students may need fundamentals in digital literacy that cannot be learned through recreational gaming, despite these games popularity. If educational games are modeled off of popular recreational games, then they too, may not be able to teach the skills necessary for life outside the classroom.

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