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## STEM, Video Game Play, & Gender = Personalization

Wendi M. Kappers

Embry-Riddle Aeronautical University, [kappersw@erau.edu](mailto:kappersw@erau.edu)

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Dr. Wendi M. Kappers, [kappersw@erau.edu](mailto:kappersw@erau.edu), 600 S. Clyde Morris Blvd., Daytona Beach, FL 32114, 386-226-6432

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## **STEM, Video Game Play, & Gender = Personalization**

**Dr. Wendi M. Kappers, Embry-Riddle Aeronautical University, FL**

*Wendi M. Kappers, PhD. is the Discipline/Program Chair of the M.S. in Information Security & Assurance Program/Assistant Professor rank [1].*

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### **Abstract**

It is imperative when utilizing educational video games in K-12 classrooms that student preferences regarding game play, purpose, and design be considered to maximize game play efficiency for learning. As Web 2.0 content infiltrates our educational medium, student customization is key. This manuscript intends to share customization requests gleaned during an 18-week experimental study examining educational video game effects upon 7th graders enrolled in Mathematics and Mathematics 2 courses.

### **Introduction**

There are controversial findings found within the literature during the past decade, discussion provided within the Historical Perspective section of this article, concerning the many possibilities for learning, or lack thereof, with regard to utilizing educational video games as learning tools. One such area of discomfort for the field stems from a possible inequality between the sexes when utilizing educational video games as a teaching medium. However, as diffusion of technology occurs with successive generations, concrete, yet repetitive, empirical evidence is needed to expose true and consistent empirical support in order for future research to become more powerful while allowing our field of Educational Research and Instructional Design to move beyond stereotypes, unfounded beliefs, and educational video game bias. This manuscript intends to share findings from an eighteen-week experimental study, conducted during the 2008-2009 school year, examining educational video game affects in a K-12 classroom between the sexes; one that posits social collaboration and tool utilization are one with end user customization as the driving force. Such interface demands inform designers to the varying customization requests of the digitally fortunate, while squashing previously perceived educational differences reported between the sexes with regard to game play and repurpose of educational tool.

### **Study**

An experimental research study was conducted to examine educational video game effects on mathematics achievement and motivation between sexes to aid to the empirical evidence. A pre and post interview sample was randomly generated to explore the views of the treatment group, derived from 7<sup>th</sup> grade mathematics (Mathematics 2/Mathematics 2 Advanced) class (n=60) learning algebra.

The study took place over an 18-week middle school session or term and applied an educational video game as the treatment. The applied treatment included a suite of single and multi-player educational mathematics video games that addressed pre-algebra and algebra concepts designed in mission format. The game consisted of 20 missions or levels; all aligned to both state and national mathematics standards. The video game suite provided visual and verbal feedback designed to engage students in the learning of algebra concepts. The treatment has been advertised by the vendor as providing an immersive 3-D video game and gaming world for learning.

Although this article provides a summary of quantitative findings, the majority of this article is dedicated to the presentation of the qualitative data as the researcher believes these data usurp quantitative findings uncovered through statistical calculation since game play is considered an individual experience (Gee, 2003). Pre/post interview data surrounding the likes, dislikes, suggested game improvements, and overall acceptance of game play in comparison to traditional teaching methods compose the qualitative aspect of this study.

### **Sample**

The population for this study was comprised of a large urban Florida county middle school, specifically 7th graders. A purposeful sampling strategy obtained included one consenting middle school teacher, along with 60 7th graders (males=29, females=31), not taking Algebra I or PreAlgebra offerings. The subject of algebra is somewhat unusual to address in normal 7th grade Mathematics 2 (n=43) or Mathematics 2 Advanced (n=17) mathematics classrooms. For course benchmark description, please refer to the Florida Department of Education references.

### **Historical Perspective**

With time and improvement in technology (Reese, 2007), mathematics and sex difference research has begun to focus on a new mathematics teaching trend, one that invokes game play in mathematics classrooms. According to Lim, Nonis, & Hedberg (2006), technology is simply an extension of a student's daily activity not a tool needing explanation, therefore, is worth considerable exploration to improve education.

**Barriers and justification for the use of video games for learning.** Not all findings, however, have supported the use of educational video games in the classroom (Kafai, 2006). Negative perceptions with regard to video games have surfaced (Mubireek, 2003). Rice (2007) summarized the views of some stakeholders that video games do not hold an affinity to learning as they are "mindless forms of activity to strong instructional content," (p. 252). Rice noted that some stakeholders have associated violence to video games but also acknowledged that those who had little to no game play exposure have made many of the negative comments documented with regard to video game usage in the classroom. Lastly, Rice identified several barriers that can add to the overall negative perception. These included (a) game graphic quality, (b) lack of classroom time for game play, and (c) inadequate representations of learning objectives when deploying video games as a teaching mechanism.

Prensky (2001), however, has reported that teachers are, for the most part, "digital immigrants" and their philosophy of teaching and/or teaching methods needs to change to match their

intended audience. Game play when learning mathematics has begun to be explored as a true potential for learning (Amory, 2007; Kafai, 2006; Ke & Grabowski, 2007; Sedighian & Sedighian, 1996). A presumption made is as diffusion of technology with successive generations disappears, video game play and technology bias from stakeholders may naturally disappear (Provenzo, 2000; Rice, 2007).

**Video game affinity.** Although video game play findings have been positive overall, Braun et al. (2001) indicated that boys had a stronger affinity for video game play than girls. This suggested a possible inequality in learning environment between the sexes. To be a successful teaching tool in the classroom, future learning must include a “desirable learning environment such that children can enter the environment with little to no knowledge of the embedded mathematical concepts” (Sedig, 2008, p. 69) and without a need to overcome a learning curve or tool, such as an educational video game.

Reese (2007) reported the historic lack of exposure to video games and video game play by females can detract from a female’s ability to utilize prior knowledge during a learning event. Activation of prior knowledge and the ability to relate to previous experience is necessary when learning. Jones (2005) has stated that the lack of video game play or exposure ultimately fails girls as they cannot “achieve goals, develop strategies, and cooperate in groups while competing” (p. 2), thus severely detracting from the learning experience.

**Secondary female-related video game utilization barriers for learning.** Research indicates that a secondary grouping of video game play barriers between the sexes dealing with video game designs include violence, negative sex stereotypes, or the lack of social aspects inclusion have contributed to the lack of female video game play (Agosto, 2004; Hayes, 2005; Jones, 2005; Ray, 2004; Valenza, 1997; Xeniya, 2015). In order to attract female gamers it has been suggested that current video game designs need to remove sex and racial bias (Agosto, 2004; Mou, 2007) or content related to “hyper-sexualized stereotypes,” (Ray, 2004, p. 35). Beginning as early as the 7th grade, females are subject to varying levels of maturity, and content including sex stereotypes or images could lead to embarrassment and create additional barriers to learning. The video game play experience then becomes a “turn-off” to the female sex (Valenza, 1997), thus, again, leading to an inequality in learning environment if being used as a learning tool.

Braun, Goupil, Giroux, & Chagnon (2001) stated that verbal and social preferences are important attributes for girls when playing games of all types. Gee (2003), however, stated each participant approaches an activity, or game play, in a very unique and individual manner; thus, one may deduct that video game play lacks social aspects need by the female gender. According to Damis-Paraboschi, Lafont, & Menaut (2005), “girls prefer verbal exchanges” (p. 180). If a game’s design is missing social aspects, the game will likely not be preferred. Thus, video games offering only individual game play experience without socialization components have not been found to provide an attractive option or learning activity for girls.

**Female-only video gaming needs.** In an attempt to explain video game play differences between the sexes, researchers specifically identify game content and design as a potential cause of the perceived lack of female video game play results (Agosto, 2004; Hayes, 2005; Jones, 2005; Ray, 2004; Valenza, 1997). Additionally, Hayes and Dickey (2006) have suggested that the market

needs to address female-only video game creations in order to capture the attention of the female audience. However, Entertainment Software Association (ESA) (2007), as presented in their 2007 Sales and Demographic Report, suggested that females are “gaming” and countered Hayes’ (2005) and Dickey’s (2006) stated need for more female-only game creations. There are hints in the literature that this disparity aligns to disparity in other areas of learning which translates to inequality in STEM (Science, Technology, Engineering, and Mathematics)-related career and involvement.

**STEM and gender.** In the last decade, there has been much emphasis upon STEM research, a majority related to the lack of STEM careers in the United States largely due to the underrepresentation of women in the workforce (Sassler, Glass, Levitte, & Michelmore, 2016). Naturally, increased examinations for using video games for learning in these areas has equally increased due to the popularity of the method for learning (Manero, B., Torrente, J., Serrano, A., Martinez-Ortiz, I., & Fernandez-Manjon, B., 2015). However, gender examinations appear absent within many studies.

Sung and Hwang (2012) and Virk, Clark, and Sengupta (2016) both explored game-based learning in science courses, whereas, Hwang, Wu, and Chen (2012) examined improved learning for web-based problem-solving. Neither study examined gender as a specific variable of investigation. Game design and development considerations were seen as a unified theme, and at times, the primary focus. Sung and Hwang reported significance in learning performance, attitudinal improvements, increased achievement, and improved self-efficacy. However, they had to additionally focus upon the grid method element implemented within the game used within the investigation; thus, warning of implementation and design considerations when implementing a video game for learning. Whereas, Virk, Clark, and Sengupta explored game design consideration extensively for the coordination of multiple external representations (MER) that support models and relationship building. Within this investigations, the author’s emphasized user-controlled environments are more supportive. While Hwang, Wu, and Chen’s topic of web-based problem-solving was unique, the investigation would not have been possible without a game specifically developed for this investigation; hence, the design of the game is just as important as the cognitive processes examined. However, there was not a consistent theme of investigation within newer video game for learning investigations.

With heavy emphasis upon the possible negative effects of using video games for learning, it is worthy to continue to investigate gender differences as a secondary game design element as well.

In summary, male familiarity with both the tool and the video gaming environment (Daviault, 2000) will continue to be seen as a disadvantage for females unless females are provided with a properly aligned tool for learning. If game designers keep to the current game development strategies of not including female preferred content, or if applying this information to educational learning tool selection processes, educators and administrators, alongside designers, will errantly implement video games without an understanding of video game play and preference between the sexes. Therefore, males will continue to have a learning advantage in all areas of curriculum when video games are utilized.

## **Findings**

A repeated-measure (SPSS v14) was used to examine results. The analysis included ethnographic results from both student and teacher interview and observation sessions for data triangulation. Results revealed a statistically significant academic mathematics achievement score increase ( $F = 21.8$ ,  $df = 1, 54$ ,  $p < .05$ ). Although, mathematics class motivation scores did not present significance ( $F = .79$ ,  $df = 1, 47$ ,  $p > .05$ ), both sexes posted similar data outcomes with regard to mathematics class motivation after using the treatment in conjunction with receiving in-class instruction. Additionally, there was an increase in male variability in standard deviation score ( $SD_{motivation\ pre} = 8.76$ ,  $SD_{motivation\ post} = 11.70$ ) for mathematics class motivation. Furthermore, data indicate there is no disadvantage for one sex over the other when learning within an educational video game setting.

Self-reported differences between the sexes for this limited sample regarding game design and observed female game play tendencies were also investigated. The data presented *customization* as a unified, and most requested, game design need between the sexes. Between sex differences were found only to be superficial other than a female delay in game acceptance regarding time and game play comfort.

During the interview process, it quickly became apparent that these students had previous exposure to video games during their schooling. This exposure caused a comparison to the treatment, thus, having a majority of students agree ( $n = 32$ ; positive = 28) that video game play was preferred to that of traditional methods which may no longer hold student interest to the extent that games can. Technology appeared to skew student acceptance of traditional teaching methods.

Students did however appreciate the ability to create and stay active while learning, but found the simplest game additions or removal of tools to be annoying. In total, shooting, war games, and character creation were high on the list of student acceptance. In the end, time spent away from the technology such as game lag or hardware freezing, created a longer than expected game return waiting period expressed by seven of the eight student interview groupings; thus, computer architecture represented 50% of the main source of irritate when playing video games in a learning environment.

It was observed by both teacher and researcher that the longer females stayed at the computer screen and involved with the video game, the easier it appeared for females to ask questions and present an increased likelihood to move beyond the initial confusion of the tool. Conversely, males appeared to have initial tool confusion, but expressed great fun in collaborating with each other; whereas, females demonstrated a need to thoroughly review game directions to achieve a confidence level to that of their male counterparts.

## **Conclusion**

Based upon this study's findings, teachers who are looking to implement educational video games in K-12 classrooms need to follow structured implementation plans to ensure technology is properly integrated. Teachers need not be overly concerned about their personal levels of video game play ability, although helpful; they should have a general familiarity of the implemented educational tool. Familiarity of tool used in conjunction with structured implementation plans would additionally help to produce the desired educational outcome.

Furthermore, educators should use vendor and school-specific implementation tools, when available, if electing to utilize an educational video game as a teaching tool or media (Kebritchi, M., Hirumi, A., Kappers, W., & Henry, R., 2008).

Educators are responsible for maintaining equal opportunities for all students (Entertainment Software Association (ESA) (2007). Therefore, teachers need to take on the task of demanding more from gaming and software companies. Game companies should survey both teachers and students alike while creating games to gather content design suggestions.

Based upon this study, differences between the sexes, when utilizing an educational video game for learning, appear only superficial, as females appear to present no outstanding achievement or motivation differences during examination. However, research regarding educational video games pertaining to instructional design outcomes must continue until overarching findings agree.

Agnostic educators must take note that games provide the impetus for academic learning. It is, however, not in the endogenous nature of students to view video game play as learning since students do not immediately associate fun or entertainment as learning. Thus, when examining motivation as a barrier to learning, the lack of significance in motivation for a topic does not necessarily equate to a negative achievement outcome. The onus of learning falls upon the teacher and district to balance the use of an emergent technology with in-class pedagogy experiences to benefit both sexes.

## Endnotes

[1] This article updates earlier publication in Academic Exchange Quarterly (2011, Play Education Video Games on Their Terms, Dr. Wendi M. Kappers), Original Submission #4867\_11, specifically the Historical Perspective section of this article has been updated. While the author's affiliation has not changed, she has transferred into a new faculty role at the university.

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