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Simulation, Gaming, and Programing in Education

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Abstract

The following research describes a study focused on enhancing thinking and reasoning by elevating teacher education to incorporate new technologies in the education of instruction. The ability to think about advanced systems and operate functions within these structures is fundamental to human development. The world is in a continuing need to advance with accuracy and optimal integrity. Games, Simulation, and Programing are introduced as ideal means of heightening learning experiences to support student exploration and construction to be able to develop these thinking competencies. Teacher education candidates were presented new technologies and readings on their integration into instruction and asked to develop lessons and projects applying use of new gaming, simulation, and programing technologies to support student development. Lessons and projects revealed an immensely innovative range of instruction designed to advance thinking.

Keywords

Technology, Education, Programing, Learning, Instruction, Simulation

1. Introduction

There is an increasing need for elevating psychological and physical development through the advancement of thinking skills. New technologies, such as simulation, gaming, and programing, offer incredible opportunities for experiencing the need for the use of advanced thinking. Simulation involves a microworld representing a place and situation through graphics and interactive travel. Gaming comprises a set of structured activities often involving a competitive task. Programing incorporates designing procedures to create some functions. Use of these technologies is likely to lead to stimulating knowledge and skill advancements. Training of teachers to incorporate use of these technologies

in the classroom is an optimal vehicle for increasing mental activity with these technologies everywhere.

Simulations and microworlds provide contexts for exploration of whole bodies of information. Environments and aspects of environmental circumstance can be represented to activate comprehensive understanding. Games and gaming also present contextual happening, also providing holistic knowledge. Programing simulation stimulates functional comprehension, connecting functions with outcomes and systematic existence. These forms of technology exercise thinking about components and structures, furthering systems intelligence.

Many researchers and technology developers have advocated the use of simulation, gaming, and programing in exploration and artifact construction. Adams (1999) encouraged the use of SimCity in teaching and learning. Sarama and Clements (2002) and Edwards (1991) support the use of microworlds as exploratory environments for study. Schmitz et al. (2015), Sheehy (2011), Renaud and Suissa (1989), Ruben (1999), and Kafai and Burke (2016) promote games as a foundational activity for learning and connecting information. Hijón-Neira et al. (2017), Shin and Park (2011), Rieber (1996), Papert (1980), Papadakis and Orfanakis (2018), Maloney et al. (2008), Leelawong and Biswas (2008), Kiss and Arki (2017), and Kafai (1994, 2006), and Kafai and Burke (2013) highlight the power of programing in construction of simulation and games as a mode of expanding thinking and creative action. This research is in sync with these thinkers in believing in the power of simulation, gaming, and programing to explore, practice, and contextualize, and also particularly focuses on the impact of these technologies in furthering experience and thinking to see whole systems and functions within systems to improve cohesive and connected thinking.

An online School of Education included a course in Technology in the Curriculum in a sequence of courses designed for current and future educators to develop technology and learning integration skills. Course learning outcomes include critiquing instructional design of educational technology and creating applying these theories. A particular component of the course was dedicated toward developing programming and simulation in education. Kaplan (2017) describes the full course and course components.

The objective of this research was to develop teacher activation of and simulation, gaming and programming in education. A further goal was to develop the online instructional technologies to accomplish this goal. This paper describes a study in training teachers to understand and apply simulation, gaming, and programing in instruction. The design of the study is presented in Section 2. Participant, instrument, and analysis information is presented in Subsections 2.1 through 2.3. The course Modules are described in Section 3. Results are presented in Section 4. The Conclusion is given in Section 5.

2. Design

2.1. Participants

Study participants included a California School of Education Credential and

Master of Education students enrolled in Technology and the Curriculum over the course of several terms over two years. Twenty of sixty students volunteered to include their work in the study, four male and sixteen female, when asked with no pressure if they would include their work. Volunteers in the study did not differ in quality of work compared to non-volunteers. The participant body was made up of teachers and teachers in training on intern and student teaching tracks in special education, single subject in varying subject areas and multiple subject credentials. Selection was determined by required participation in the course and volunteering for the study. The volunteers were representative of the course participants and teacher candidates in the University.

2.2. Procedure and Instruments

The course was divided into eight weekly modules covering technology in curriculum theories. Each module covers a set of theorists in technology in the classroom and instructional design. Modules include: 1) Blended Learning & Flipped Classrooms, 2) Technology & Education Policy, 3) Media Literacy, Learning Theories, Multimedia & Introduction to Instructional Design, 4) Anchored Instruction, Situated Cognition, & Goal-based Scenarios, 5) Teaching and Learning by Design, & Problem and Case based Learning, 6) Games, Simulation, Microworlds & Programing, 7) Communities of Practice, Learning Communities, Data Analysis and Visualization, and 8) Technology in Education Evaluation. The modules are made up of resources including links to course content and assignments and communication forums. Resources include readings and applications. Assignments include reviewing and discussing application of theories, creation of artifacts applying theories, and evaluation of artifacts applying theories. Assignment categories include discussion, course project, and lesson plans. Additionally, the course included a Syllabus, Announcements, Course Materials, Discussions, Conferences, Grades, Chat, and a Questions center.

Study instruments were embedded into the Technology and Curriculum course in the Simulation, Gaming, and Programing Module. Participants were presented with resources and assignments comprised of lesson designs and projects. Participants completed activities individually and in groups during the course of the week of the module and submitted their assignments online. Understanding and application of theory were measured in lesson designs and group project designs received through online submissions in digital word or web format. Lesson designs required selection of a topic to teach based upon State Standards with a design incorporating the reading. Project designs were culminating group or individual work incorporating the reading into projects to improve critical thinking.

Two sets of prompts were utilized. The first prompt queried lesson designs incorporating theories of virtual collaboration and communities of practice. Participants were directed to adapt one of their lessons designs to incorporate Simulation, Gaming, and Programing. The second prompt queried applications of theory and design in collaborative projects involving Simulation, Gaming, and

Programing in action. Participants were directed to brainstorm in their project groups how Simulation, Gaming, and Programing might be integrated into the group project.

2.3. Analysis

Student research and constructions were analyzed for theory understanding and referencing and application of theory in education. Theory discussions and analysis noted whether they acknowledged and noted theory and what they found relevant in the theory. Lesson analysis involved accounting for and describing referencing to theory and application of theory in lesson design. Projects were analyzed for theory referencing and application in project design.

3. Games, Simulation, Microworlds, and Programing Module

Module 6 is a unit on Games, Simulation, Microworlds, and programing in Education. The goal of the module is to provide an overview of these new technologies in Education theories and applications. Learning objectives included analyzing Gaming, Simulation, and Programing theories and applications and determining how to effectively apply the principles in Education theories and applications in lesson plan and project design.

The module is made up of readings, forums, and assignments. Readings included Papert (1980), Turkle (1997), Kafai (2006), Sheehy (2011), and websites such as Scratch at MIT Media Lab, Squeakland by Alan Kay and Viewpoints Research, and Second Life by Linden Research. Readings present Games, Simulation, Microworlds, & Programming in Education theories and applications. Assignments include brainstorming in project groups over how to incorporate Games, Simulation, Microworlds, & Programming in Education theories and applications into project design, selecting insights from Games, Simulation, Microworlds, & Programming in Education theories and applications and incorporating into lesson designed in previous modules, and providing meaningful feedback to classmates' lesson designs.

4. Results

Table 1 shows a number count for whether Simulation, Gaming or Programing were referenced and applied in lessons and projects out of twenty-participants.

4.1. Applications in Lesson Designs

Table 1 shows 20 of the 20 participants successfully inferenced and applied

Table 1. Reference and application of theory.

Reference and Application of Theory	Activity	
	Lessons	Projects
	20	20

theories and technologies in lesson designs. Participants created incredible lessons incorporating newly investigated technologies. One modification to lesson design incorporated the use of MadLibs in instruction and encouraging a game-like environment when writing sentences in groups. Another modification to instruction involved the use of Revolution K-12 and Kahoot to practice math problems. One student lesson modification involved designing an animation in Scratch, a programming and simulation building authoring tool, to rewrite the ending of Peter and the Wolf in a lesson on writing. One lesson modification incorporated exploring simulated constellations and star charts to understand star constellations. Another lesson modification involved using Kerbal Space Program to simulate building and flying their won space craft.

One lesson modification included having students design games in Scratch with certain game dimensions and use Minecraft to solve math problems. One student incorporated teaching programming concepts such as conditional loops. Another lesson development involved having students design their own settlements, conduct archeological digs, and participate in virtual museum tours. One lesson involved simulating being a trainer for diet and exercise, responding to character cases of dietary and workout needs. One lesson adaptation involved including use of programs such as MathBlaster, Scratch, and Etoys in learning multiplication skills. Another lesson adaptation involved including gaming and simulation in problem solving and in guided practice.

One lesson in learning how to play basketball was adapted to include simulated playing. One lesson in fifth grade math involved calculating measurements and dimensions of a dream house in an Etoy creation. One kindergarten lesson involving teaching children plant survival incorporated use of simulated plant watering programs. One lesson in health was adapted to include a gaming station where students could select healthy snacks. Another lesson has students designing simulations of assumptions about Dracula. An art lesson incorporated the use of a new Art Games site and drew and sketch apps on the telephone. A kindergarten lesson incorporated the SeeSaw program in simulated construction of a real site.

4.2. Applications in Project Designs

Table 1 shows 20 of the 20 participants successfully inferenced and applied theories and technologies in project designs. Project designs embedded spectacularly original instructional design. In a project on learning about Missions, 4th grade students were encouraged to make websites, powerpoints, and youtube videos. In a project on educational technology integration for teachers in math education, students are encouraged to make games in Kahoot that teach multiplication and division with fractions. In a project on solar system exploration, students are encouraged to work with star charts in interactive games.

In a project integrating technology in the classroom with a shared site, students are encouraged to create a game in Scratch that includes equations from the math concepts studied. In a project on computer science, students are asked

to build scratch etoys to learn to think with conditionals. In a project for high school physical education, students are placed in a simulation on health and nutrition.

In a project on technology integration, students were encouraged to play video games and make games in Scratch, a simulation programing tool. In a project teaching music, students are encouraged to play a game asking them to identify cultural aspects of music videos and create lyrics based upon their own life experiences. In a visual art project on geometric mandala, students are encouraged to make mandalas in Minecraft and Robox, allowing them to create geometric shapes in virtual worlds. In a project integrating technology into the kindergarten classroom, students are encouraged to program teaching agents.

5. Conclusion

This course was successful in inspiring teacher candidates to analyze and apply simulation, gaming, and programing to instruction with remarkably creativity. Upon reading theories in simulation, gaming, and programing, teacher education candidates analyzed applied theories in meaningful ways in lesson designs and final projects. The results of this study suggest simulation, gaming, and programing can inspire the teaching of teachers in developing their knowledge and skills needed to shape student development. Participants developed instruction incorporating games, simulation exploration, and construction of simulated programs.

Results show participants were able to understand and reference the theories and it is most likely this is a result of exposure to the reading resources. A future study might pretest knowledge and compare groups who have experienced the resources and/or instructional activities and groups who have not made a causal claim about instruction.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Adams, P. C. (1999). Teaching and Learning with SimCity 2000. *Journal of Geography, 97,* 47-55. https://doi.org/10.1080/00221349808978827

Edwards, L. (1991). Children's Learning in a Computer Microworld for Transformation Geometry. *Journal for Research in Mathematics Education, 22,* 122-137. https://doi.org/10.5951/jresematheduc.22.2.0122

Hijón-Neira, R., Santacruz-Valencia, L., Pérez-Marín D., & Gómez-Gómez, M. (2017). An Analysis of the Current Situation of Teaching Programming in Primary Education.

In *2017 International Symposium on Computers in Education (SIIE)* (pp. 1-6). IEEE. https://doi.org/10.1109/SIIE.2017.8259650

Kafai, Y. B. (1994). *Minds in Play: Computer Game Design as a Context for Children's Learning.* Routledge. https://doi.org/10.4324/9780203052914

Kafai, Y. B. (2006). Playing and Making Games for Learning: Instructionist and Constructionist Perspectives for Game Studies. *Games and Culture, 1,* 36-40. http://0-gac.sagepub.com.library.alliant.edu/content/1/1/36.full.pdf+html https://doi.org/10.1177/1555412005281767

Kafai, Y. B., & Burke, Q. (2013). Computer Programming Goes Back to School. *Phi Delta Kappan, 95,* 61-65. https://doi.org/10.1177/003172171309500111

Kafai, Y. B., & Burke, Q. (2016). *Connected Gaming: What Making Video Games Can Teach Us about Learning and Literacy.* MIT Press.

Kaplan, D. E. (2017). Creative Technology in the Curriculum in Online Teacher Training. *Creative Education, 8,* 1223-1235. https://doi.org/10.4236/ce.2017.88087

Kiss, G., & Arki, Z. (2017). The Influence of Game-Based Programming Education on the Algorithmic Thinking. *Procedia—Social and Behavioral Sciences, 237,* 613-617. https://doi.org/10.1016/j.sbspro.2017.02.020

Leelawong, K., & Biswas, G. (2008). *Designing Learning by Teaching Agents: The Betty's Brain System*. Department of EECS/ISIS, Vanderbilt University.

Maloney, J. H., Peppler, K., Kafai, Y., Resnick, M., & Rusk, N. (2008). Programming by Choice: Urban Youth Learning Programming with Scratch. In *Proceedings of the 39th SIGCSE Technical Symposium on Computer Science Education* (pp. 367-371). Association for Computing Machinery. https://doi.org/10.1145/1352135.1352260

Papadakis, S., & Orfanakis, V. (2018). Comparing Novice Programming Environments for Use in Secondary Education: App Inventor for Android vs. Alice. *International Journal of Technology Enhanced Learning, 10,* 44-72. https://doi.org/10.1504/IJTEL.2018.088333

Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas.* Basic Books.

Renaud, L., & Suissa, S. (1989). Evaluation of the Efficacy of Simulation Games in Traffic Safety Education of Kindergarten Children. *American Journal of Public Health, 79,* 307-309. https://doi.org/10.2105/AJPH.79.3.307

Rieber, L. P. (1996). Seriously Considering Play: Designing Interactive Learning Environments Based on the Blending of Microworlds, Simulations, and Games. *Educational Technology Research and Development, 44,* 43-58. https://doi.org/10.1007/BF02300540

Ruben, B. D. (1999). Simulations, Games, and Experience-Based Learning: The Quest for a New Paradigm for Teaching and Learning. *Simulation & Gaming, 30,* 498-450. https://doi.org/10.1177/104687819903000409

Sarama, J., & Clements, D. (2002). Design of Microworlds in Mathematics and Science Education. *Journal of Educational Computing Research, 27,* 1-5. https://doi.org/10.2190/P9GT-RN11-3AY3-WBG6

Schmitz, B., Klemke, R., Walhout, J., & Specht, M. (2015). Attuning a Mobile Simulation Game for School Children Using a Design-Based Research Approach. *Computers & Education, 81,* 35-48. https://doi.org/10.1016/j.compedu.2014.09.001

Sheehy, K. (2011). *High School Teachers Make Gaming Academic.* U.S. News and World Report. http://www.usnews.com/education/high-schools/articles/2011/11/01/high-school-teachers-make-gaming-academic?int=96e908

Shin, S. K., & Park, P. W. (2011). *A Study on Teaching and Learning for Math Education at Elementary School with Scratch Programing.* Korea Association of Information Education.

Turkle, S. (1997). Seeing through Computers (pp. 76-82). *The American Prospect.*