

A wooden abacus with multiple rows of colorful beads (yellow, purple, blue, red, green) is shown in the background, slightly out of focus. The text is overlaid on this image.

Implementation of Gamification and Digital Game-Based Learning into STEM Related Subjects

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Abstract

Gamification is a concept that has been utilized as a supplementary tool in and out of classrooms since before video games, and even its own definition, were as established in mainstream conversations today. Gamification is a common tactic used in educational, workplace, and commercial settings to promote engagement of participants, otherwise known as “players.” A term coined in 2002 by Nick Pelling and later redefined in 2014 by Gartner, gamification refers to the integration of core gameplay mechanics-- such as rules, level progression, challenges, and rewards-- and tends to result in an increase in engagement and investment in the different areas of activity it is applied to [15].



Abstract (continued...)

According to Gartner, gamification “focuses on enabling players to achieve their goals” by aligning task goals with “player” goals which leads to the consequence of the task being completed because of this alignment [16]. Gamification can occur in both digital and analog experiences, digital referring to engagement via the incorporation of computers, smartphones, and associated applications while analog references non-digital components such as loyalty cards or best attendance in a classroom. For the context of this team’s goals, the focus was on the implementation digital gamification. Gamifying an everyday task or topic increases an individual’s enjoyment and personal investment in a task because the incorporation of these gameplay elements breaks the mundanity of a simple activity and elevates it by adding a driving motivation of reward.




Abstract (continued...)

When applied to an educational context, enjoyment, engagement and investment in a subject have been shown to result in higher retention of the information learned [17]. Several studies have argued that gamification in education has a positive effect on learning and student achievements in classrooms [18]. By gamifying difficult subjects that have a tendency to be seen as “dry” and “technical” by younger participants, such as math and science, students have the potential to comprehend them at a faster rate. When applied to an educational context, enjoyment, engagement and investment in a subject have been shown to result in higher retention of the information learned [17].




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Several studies have argued that gamification in education has a positive effect on learning and student achievements in classrooms [18]. By gamifying difficult subjects that have a tendency to be seen as “dry” and “technical” by younger participants, such as math and science, students have the potential to comprehend them at a faster rate. Digital game-based learning, a similar concept to gamification with the express difference of actually incorporating “learning principles into immersive video game environments into immersive video game environments in an effort to provide a new tool for education that is as modern and adaptive” according to Prensky [19].



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Video games represent a unique potential for educators because of their interactivity, accessibility, and the format's tendency for modification especially in relation to the implementation of different curriculums across grade levels. Digital game-based learning, a similar concept to gamification with the express difference of actually incorporating "learning principles into immersive video game environments into immersive video game environments in an effort to provide a new tool for education that is as modern and adaptive" according to Prensky [19]. Video games represent a unique potential for educators because of their interactivity, accessibility, and the format's tendency for modification especially in relation to the implementation of different curriculums across grade levels.

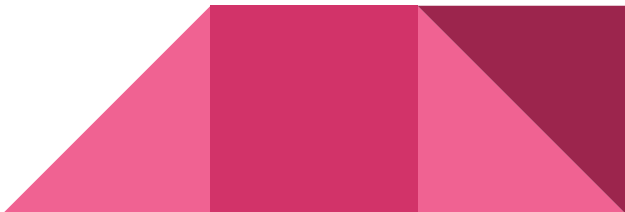


Abstract (continued...)

The goal for this team was to encourage the incorporation of digital gamification of STEM concepts in K-6 educational settings through digital game-based learning. To accomplish this goal, the team set the objectives of conceptualizing and developing a digital, educational video game that can be further modified to incorporate different STEM-related curriculum and grade levels. This was completed utilizing Unreal Engine 4 to build and develop graphical and interactive components. The team also referenced the North Carolina Common Core Curriculum to develop educational questions to implement into the video game.



Research Questions

- What is gamification?
 - What is digital game-based learning?
 - How can education and game development connect?
 - What are the benefits of gamification and digital game-based learning in the classroom?
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Gamification

- Merging gaming elements with non-gaming environment
 - Classrooms and Workplace
- High levels of interaction
- Integrating Game Mechanics
 - Story, Rewards, Levelling, Rules
- Educational
 - Khan Academy
 - IXL



Digital Game-Based Learning

- Integrating Learning Principles into an immersive game environment
- Any situation in which digital games are leveraged to support learning
- Promotes student-centered approach to learning
 - Kahoot



Gamification in Education: Then vs. Now

- Then
 - Designed for mathematics and science
 - Programmed by teachers
 - Discrete
- Now
 - Distinguishment between playful vs. serious games
 - Playful: aesthetics
 - Serious: real-world simulation



Gamification in Education: 7 Objectives of an Educational Game

- Mastering skills
- Challenging
- Engaging
- Improving learning
- Behavioral change
- Socialization
- Guidelines



Gamification in Education: Learning Styles

- Visual
- Auditory
- Physical
- Verbal
- Logical
- Social
- Solitary



Benefits of Game Development

- Objective: increase the difficulty of game
 - Aids in overcoming dyslexia
 - Improves balance
 - Increases decision making speed
 - Reduces stress and anxiety levels
 - Encourages teamwork
 - Improves motor skills
 - Enhanced socialization and career-building skills



Methodology

- Concept

- Defining Targeted audience
- Unreal Engine 4 (UE4)

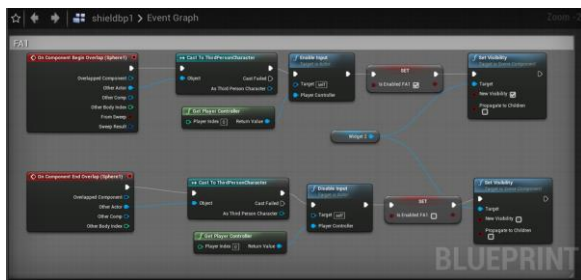
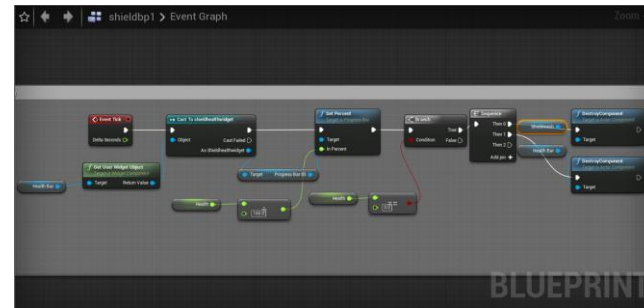
- Pre-Production

- Game design document
- Mechanics
 - Player solve mathematical problems by interacting with the elements in the game
 - Player can “blast” aliens off the planet



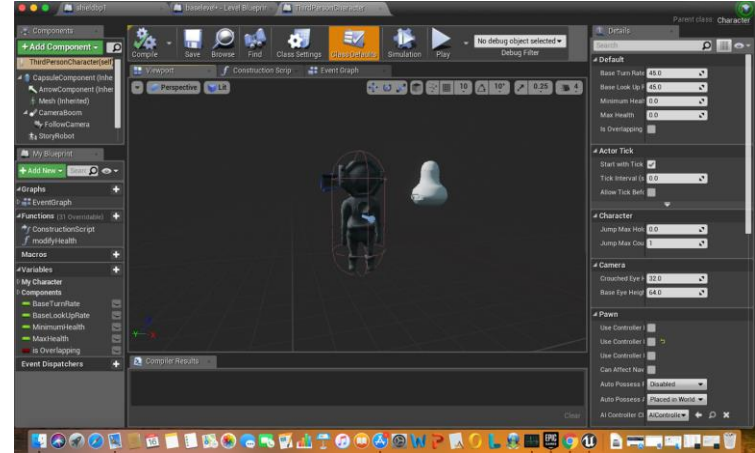
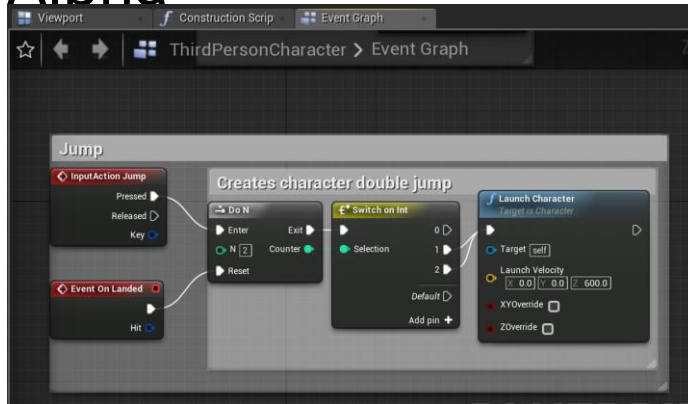
Methodology (continued...)

- Production
 - Shield blueprint
 - Shield health system
 - Kiosk blueprint



Methodology (continued...)

- Production
 - Characters
 - Mechanics
 - Story elements
- Pre-Alpha



Conclusion: Gamification

- Gamification in education is possible
- Gamification of mathematics is possible
- All students are included
- Games can be content heavy in relation to STEM-Based Curricula



Conclusion: Complications and Challenges

- Unfamiliar with Unreal engine environment
- Restricted time frame
 - Game Development Cycle is a year+ long process
- Bugs in the code
- Limitations
 - Resources
 - Equipment-dual screen computers



Future Work

- Expand game availability to other grade levels
- Implement more game mechanics
 - Visuals
 - Game interaction
- Beta-testing
- Survey
- Collaboration with local educators
 - Does our game strengthen students' comprehension?



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Thank You

Questions?

