GAMIFICATION AND THE 5E LEARNING CYCLE

Background:

A common problem faced by many science students is that their classes are not engaging or motivating and end up punishing students for failure. To improve student success and scientific literacy, I developed an engaging and pedagogically-sound intervention to determine the impact of utilizing gamification and the 5E learning cycle (QuIVERS) with high school honors chemistry students.

People love to play video games; including many of my students and myself. Many people devote hours to video games, and despite their difficulty or their frequent encounters with failure, they persist at learning the skills needed to be successful at those games. The goal of this project was to use a variety of compelling aspects of video games and incorporate them into my classroom to improve my student's success at learning chemistry and to foster their identities as scientists.

Research Questions:

<u>Focus Question and Sub-Question:</u>

1) Will implementing elements of gamification and the 5E learning cycle into a classroom environment improve student performance?

2) Will implementing elements of gamification and the 5E learning cycle into a classroom foster student identities as scientists

Data Collection/ Analysis Methods:

Focus Question:	Data Source 1	Data Source 2	Data Source 3
Primary Question:	Formative Assessment Grades	Summative Unit Tests	Teacher Journal and Field Note Observations
Sub Question:	Pre-treatment and Posttreatment Attitude Survey	Student Interviews	Teacher Journal and Field Note Observations

Data:

Table 2

Pre- and Post- Intervention Assessment Analysis (n=?)

Pre- intervention analysis						
	Ch. 7 Test	Ch. 7 Quiz 1	Ch. 7 Quiz 2	Ch. 7 Quiz 3	Ch. 8 Quiz	Ch. 8 Test
Mean %	82.89	87.28	87.93	88.03	93.85	79.00
Std. Dev.	3.98	1.10	1.50	1.48	1.33	5.07
Post- intervention analysis						
Mean %	80.12	88.33	87.62	85.24	92.54	82.86
Std. Dev.	4.97	1.29	1.37	1.81	1.60	4.00

Table 3

Patterns in scientific identity open-ended question

Comment	Percentage Before (19 respondents)	Percentage After (16 respondents)
Make Claims and support with evidence	32%	44%
Enjoy learning	11%	25%
Collecting data	5%	13%
Making models	0%	6%
Experiment and test	16%	19%
Solving problems	11%	19%
Asking researchable questions	21%	19%
Wonder and curiosity	16%	6%
Explore	11%	6%
Be observant	5%	6%

Methods:

I used a gamified learning environment that used a modification of the 5E learning cycle (QuIVERS) to deliver content. The intervention was inspired by Paul Andersen, who developed the QuIVERS method for his AP Biology classes.

Within this cycle students engage in a question, explore an investigation, watch a video, read an elaborative reading, review, and take a summary quiz.

In my intervention, I incorporated the following characteristics of gamification: self-paced advancement, failure normalization, badges for completing challenges, and levelling. Participants completed challenges and earned badges linked to specific learning objectives to demonstrate mastery. As they chose to complete required and optional challenges, they earned badges and gained levels as they progressed through each unit's learning objectives. Unit modules were constructed in the context of a video game, complete with backstory where students embarked on an adventure where they became research scientists in a game with avatars that they themselves drew and designed.

Students also were involved in collaborative learning through Chem-guilds– small heterogeneous groups of students who worked together to solve additional challenges and earn special badges.

Treatment:

The study began with a non-treatment control group from the previous year. Class averages, formative assessment scores, and summative assessment scores were recorded for comparing with the treatment group. Two units of the study, nomenclature and chemical reactions were used at the treatment units. The assessments included three nomenclature quizzes and a multiple choice test for the nomenclature unit, and a balancing equations quiz and multiple choice test for the chemical reaction unit.

During these units, elements of gamification and the 5E learning cycle were incorporated to improve student understanding of the content and to foster student identities as scientists.

Results:

Overall, the impact on student learning and student identity as a scientist was inconclusive and it appeared that the intervention had no significant impact on either.

Changes were small in many of the measured standards. Students seemed to be most impacted in their confidence and willingness to learn in environments where failure was encouraged. The majority of students found the intervention positive and helpful. My results matched the research that demonstrated that student engagement, achievement, and motivation all can be affected positively by high-quality games and holistic classroom game environments.

An increase in the duration of the intervention could be used to see if there is a stronger impact on student learning and to help foster identities in science content could be incorporated in ways that involve more science practices and inquiry.

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