

Methods in Active Inquiry Based Learning toward Motivation and Engagement

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Introduction:

Education professionals are always looking for the methods to engage students in effective and exciting learning. This has led to the development of many variations on student centered learning: project-based, problem-based, challenge-based, game-based, and gamification. It is unclear which of the many varieties of active learning are the most effective or if there aspects that each method shares with the others that makes them more enticing to students, and thus more motivating and engaging.

Research Questions:

- 1) To what extent did engaging students in challenge-based, project-based, problem-based, game-based learnings and gamification change their motivation and engagement in my engineering class?
- 2) What factors lead to students increased motivation and engagement?

Connection to Industry:

My work at Paragon Space Systems and Ventana Medical Systems showed me how real engineers and scientists do their jobs. I gained perspective from two different companies while working in a variety of jobs in each. Although there are big differences in the industries, the principles I gained are very similar.

People actively perform work whether using a computer to draw a schematic or physically building a part, there is an active component to what employees, engineers, scientists, and technicians are doing. Active work can also mean meetings and lectures to learn new information and use books for research. Although work isn't always physical, it is always dynamic.

Having pre-set answers is rare. Having to figure out the answers and finding solutions are much more common place. And even when someone has an answer, individuals work to understand if it is the best possible answer. Employees are constantly pushing themselves to improve. These insights pushed me to find ways to engage students in active learning.

Investigation:

This investigation was conducted over the 2013-2014 school year. I taught six course sections: Engineering and Robotics. Students could request to be in the course, but there were a significant number of students that did not want to be in the course or were at least indifferent to the course from the beginning. During the year, students are in and out of the classes for a variety of reasons.

Two surveys were used to assess students' engagement. The first survey was designed to assess competitiveness and engagement in projects and included students' career interests. The second survey was designed to assess how students felt about the projects we did during the year and various project characteristics.

Foundational Characteristics of Projects:

- Simulator** (Game Based) Hands On, Realistic, Low level Problem Solving, Individual/Pairs
- SimCity** (Game-Based, Gamification) Hands On, Medium Problem Solving, Individual
- Future City** (Problem Based, Gamification) Hands On, Realistic, High Level Problem Solving, Small Group
- UAV/Drone** (Challenge Based, Gamification) Hands-On, Low Level Problem Solving, Small Groups vs Large Group
- Lego NXT** (Project Based) Hands on, Small Group
- Scratch** (Traditional Integration Learning) Hands On, Medium Problem Solving, Individual



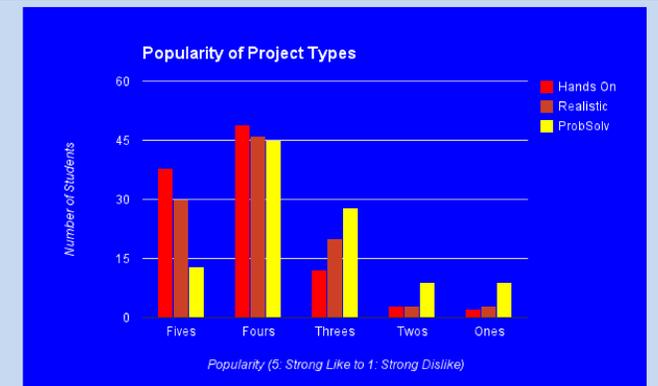
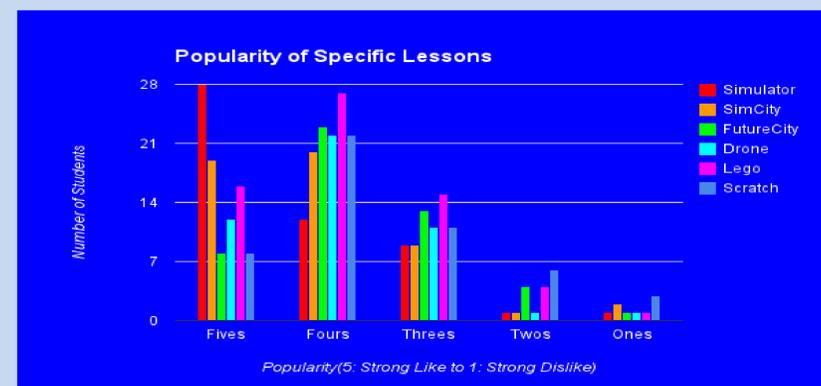
Data and Analysis:

Data was collected through an early year survey that asked about student interests and their self-evaluation of how competitive they thought they were. At the end of the year, students completed an exit survey that asked them to reflect on their overall perception of the STEM courses we offer (math, science, and engineering), the various projects we did, and the aspects each of the projects had in common, hands-on, problem solving, and relevance. Students were also asked about their interest in college and careers. I analyzed the survey data using descriptive statistics.

Results:

Students who completed the courses were not only positive about their projects, but were more motivated in the content basis for the projects. When compared to each other, students seemed to enjoy the projects equally. The chart below shows students' ratings of topics from 1 (did not like) to 5 (liked a lot).

While developing the lessons, I noticed similarities in the fundamental approaches of all the lessons leading to a common "what's" but differing "how's". All the approaches had activity based-learning with some sort of hands-on activity. All of the methods also had a form of inquiry-based learning that engaged students in problem solving.



In addition, by the end of the year, students also seemed more likely to want to go to college. Of the 105 students surveyed, 100 specifically said they wanted to go to college. Of those, 54 wanted to go into STEM careers.

Students reported that they liked doing projects and building but did not like working with other people.

Findings:

Students liked projects that were hands-on, relevant, and included problem solving. The method of teaching, such as problem-based, mattered more than the topic being taught, like environmental engineering. Overall, no one method was better at engaging students – the elements that they had in common were the effective aspects of engagement.

Changes to Practice:

Of the 21st Century Skills, collaboration is the most essential. In the future, I will need to emphasize the importance of group work and collaboration. I need to allow students to experience a variety of project methodologies. By allowing multiple types of projects, regardless of the topic, I will have greater flexibility to engage my students in exciting hands-on, relevant work.

I will change my lessons to be less about specific processes and more about aspects that engage students to want to learn more about engineering and science. By doing so, the topics become more approachable and relevant to future work.



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