Undergraduate Thesis Prospectus

Supplementary Online Learning Tools

(technical research project in Computer Science)

How Innovative Instructors Improve Student Participation

(STS research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem

How can we promote student success in the classroom?

Early childhood success is important. According to Ball (1994), "investment in good early learning for all its children is arguably the best investment a nation can make." Better early childhood education increases test scores in higher grades. (Belskey et al., 2007)

A Gamified Course Visualization, Organization, and Assessment System

Mark Floryan, a Computer Science professor at the University of Virginia, is dissatisfied with the way classes are currently taught. Floryan believes that strict deadlines and one-time assessments are not optimal for learning. Floryan seeks to understand the efficacy of gamification as an alternative method for learning. In his proposed system, students advance through a course as they advance through a video game: at their own pace, with deliberate practice and immediate feedback. Course material will be organized by topic, allowing for class progress to be visualized as a graph. Professors and students alike can see their progress in real time with on-site quizzes and automated grading.

Many classrooms today use the lecture-based exam model. In this model, lectures are the foundation of the course; quizzes, homework, and exams are all contingent on the lecture material. This solution forces students to learn at a controlled pace outside of the classroom, often causing students to move on from a topic before they have mastered it. Floryan's system aims to allow students to work at their own pace outside of the

classroom and to make the mastery of a topic feel like beating a difficult boss in a video game.

Requirements are important because they enable clients to express their desires in a clear and unambiguous way. By converting client wishes to requirements and reviewing those requirements with customers, software developers can confirm that the product they will create matches the client's needs.

In the previous academic year, this project was started by a different team under the original set of requirements. Our contribution to the system includes adding security and authentication, improving performance at scale, aligning the system with Floryan's course, and adding quizzes and auto-grading. Based on several meetings with Floryan, we assembled this list of requirements for our contribution.

Minimum Requirements:

- The system must secure student data and grades such that they are only accessible by that student and by the course staff
- As a professor, I want students to only be able to see course topics that have been unlocked
- As a professor, I want to be able to lock and unlock topics from within the client
- As a professor, I want the students to be able to see their grade for level of competency per topic
- As a professor, I want to be able to upload grades in csv format
- As a professor, I want to be able to upload large amounts of data quickly (50,000 instances)
- As a user, I want the system front end to not experience notable lag when the database contains large amounts of data

Desired Requirements:

- As a TA, I want to be able to access and modify student grades from the frontend
- The system must be secure at the network level by encrypting traffic with HTTPS
- As a professor, I want the system to be able to store arbitrary assignment grades associated with a topic
- As a professor, I want to be able to toggle between cutoff grades and percentile grades per course and per topic
- As a professor, I want to be able to customize the thresholds for cutoff grades per the

course and per topic
- As a professor, I want to be able to import grades from Bloomfield's new 2150 system
- As a professor, I want to be able to administer multiple choice questions
- As a professor, I want to be able to auto grade quiz submissions and provide immediate feedback
- As a professor, I want to be able to administer parson's problem questions
- As a professor, I want to be able to create quizzes from a question bank and to specify how the quizzes are to be generated
- As a professor, I want to be able to administer short answer questions
- As a staff member, I want to be able to grade short answer questions

Optional Requirements

- As a professor, I want to be able to administer short answer questions
- As a staff member, I want to be able to grade short answer questions
- As a professor, I want to be able to administer and grade coding questions

Figure 1.

How Schools Improve Student Success

How are U.S. schools seeking to better serve students?

According to Bergen (1998), teachers "must become facilitators of learning by becoming supportive rather than directive with their teaching." Directive teaching limits students' initiative. Some teachers use application-based instruction in which students use what they learn, which can improve student performance relative to memorization for tests. (Khurshid & Ansari, 2012).

From experience, Sophia Pappas, a former early-childhood educator, learned that "play creates important entry points for kids on all different levels" (Stringer, 2018). Barros et al. (2009) found that unstructured play increases students' engagement in learning and that "recess may have a benefit for overall group classroom behavior." Jarrett et al. (1998) suggest that "most children, both boys and girls, are renewed by a break rather than disrupted by it." Technology can help too. Guidelines from the U.S.

Department of Education's National Education Technology Plan can help teachers incorporate technology in classrooms. According to DOE (2017), "technology can help learners unlock the power of some of the most potent learning principles discovered to date."

The No Child Left Behind Act of 2001 limits local communities. According to Alyson Klein (2015), NCLB "significantly increased the federal role in holding schools responsible for the academic progress of all students." States not complying with NCLB "risked losing federal Title I money."

Some parents seek greater local control over school decisions. Parents for Quality Education, a nonprofit promoting parental involvement in education aims to achieve "true fair representation of our neighborhoods and community on the Board of Education" (Caslavka & Lee, 2019).

Standardized testing is controversial. According to Peter Greene (2015) "all tests ultimately and primarily test the student's ability to take a test." A large social media group for teachers, WeAreTeachers, compiled 31 tweets from teachers opposing standardized testing in schools. (Hudson, 2017)

PBS Educators, Scholastic Educators, and Education Next offer educational products to teachers. WeAreTeachers claims to inspire teachers through social media posts and its website. It is a subsidiary of MDREducation, which markets to teachers, parents, and students. In a blog post for MDREducation, Kristina James (2019) claimed that "Brands like Lysol, Elmer's, and Quill are … working with MDR's leading media brand for educators, WeAreTeachers, to craft unique campaigns for teachers and ultimately turn them into loyal customers."

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