Undergraduate Thesis Prospectus

A Gamified Course Visualization, Organization, and Assessment System

(technical research project in Computer Science)

The Competition for Data and Attention

(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 are sociotechnical systems affecting personal autonomy?

The 3.2 billion smartphone users worldwide in 2019 may grow to 3.8 billion users by 2021 (Newzoo). Besides supporting communication, such devices also support diverse enterprises, such as data collection, gaming, social media, and education. These enterprises play a role in identity formation, as Ramezankhani et al. (2019) notes that "adolescents' use of social media results for how they think about themselves, their family members and peers, and then shapes their insights of group norms and behavioral intentions." As sources of distraction, devices can be educational impediments. But because devices can support gamification of curricula, they can also improve classroom engagement. Social engagement facilitated by the internet may also improve cognitive function. Myhre et al. (2017) found better cognitive function in people who are socially engaged in social networking compared to people who are disengaged.

A Gamified Course Visualization, Organization, and Assessment System

How can classrooms be improved so as to increase efficacy, engagement, and feedback?

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.

The competition for data and attention

How is the internet affecting personal autonomy?

In the United States, the Internet of Things market is predicted to grow from approximately $380 billion in 2019 to $540 billion in 2022; the largest component is consumer electronics (Statista). This trend will augment data collection. Marketers value personal data as a means to personalize ads and thereby improve their efficacy. The Center for Humane Technology calls the competition for human attention "A race we're all losing," resulting in addiction, social isolation, and outrage. (Harris, n.d.). To tech companies, users' attention means access to their data, with consequent threats to users' personal privacy and autonomy.

Oulasvirta et al. (2012) found that smartphones induce checking habits that can lead users to spend more time on their device, but these habits tend to be experienced as annoyances rather than addictions, suggesting little threat to personal autonomy. Stipek and Weisz (1981) found that perceived control affects academic achievement. If checking habits are perceived as diminishing control, smartphone usage may affect academic achievement.

Google collects information about user searches, videos watched, ads clicked on, personal location data, websites visited, emails, photos, calendar events, and more (Google n.d.). With Google Analytics, businesses can collect information about website visitors with the intent of modeling their users and making smarter business decisions (Google n.d.). Lucid runs a marketplace which sells data about people and provides tools for verifying the accuracy of the data (Lucid n.d.). This marketplace attracts researchers, advertisers, agencies, and media sellers.

Time and attention are also valuable to marketers. Participants include the Center for Humane Technology, which aims to limit intrusive device use (Harris, n.d.), minimalists who favor limiting device use to tasks that align with users' values (Newport, 2019), and the tech

companies that make the devices and their applications. Facebook announced at a summit in 2017 that its mission is “bringing the world closer together” (Zuckerberg 2017). RescueTime is a tech company that sells productivity software, contending that “the modern workplace is making us more stressed, less productive, and vulnerable to burnout” (RescueTime).

Online democracy advocates warn that that personalized data collection poses a threat to peoples’ beliefs and to democracy. One such advocate, Eli Pariser, said in his book *The Filter Bubble: What the Internet is Hiding From You*, that “The algorithms that orchestrate our ads are starting to orchestrate our lives” (Pariser 2011). He elaborated: “Personalization filters serve up a kind of invisible autopropaganda, indoctrinating us with our own ideas, amplifying our desire for things that are familiar and leaving us oblivious to the dangers lurking in the dark territory of the unknown.” One researcher, Harold Holone compared personalization filters to an invisible in-car navigation system which “instead of suggesting the direction you should follow, simply takes control of your car and takes you where it thinks you want to go” (Holone 2016).

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