Prospectus

Technical

Supplementary Online Learning Tools and Course Gamification

STS

Analysis of the Effectiveness of Presentation Methods in Communicating Stormwater Management Procedures

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Overall Introduction

The technical aspect of this thesis covers the development of a web application that supplements a different style of classes. This student performance tracker, proposed by our client, Professor Mark Floryan, seeks to model a gamified classroom environment, where, unlike most common lecture styles, the assignments and quizzes in the class supplement topics from the lecture and allows students to learn at their own pace. The quizzes and homework have no specific deadline and the course is not graded based on a percentage score.

The issue of stormwater is far more complex than pollution. There exists a socio-political issue of a lack of cooperation between the government and the community when it comes to managing stormwater infrastructure. Many municipalities, especially those within the Chesapeake Bay watershed and specifically Hampton Roads, often promote social outreach programs to encourage public cooperation when it comes to dealing with stormwater and its adverse effects on the environment. It is worthwhile to consider how effective these outreach methods are and to explore the way they are presented and possibly look for alternate methods of presentation that are more receptive.

Supplementary Online Learning Tools and Course Gamification

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.

Analysis of the Effectiveness of Outreach Programs in Communicating Stormwater Management Procedures

The issue of stormwater is often seen as a mild inconvenience in our lives. After a heavy storm, some parts of roads and sidewalks are flooded for some time with stagnant puddles until they evaporate or are absorbed into the ground. However, there is also the real issue of stormwater pollution. As rain water flows across the ground, it picks up sediment, trash, nutrients, or other kinds of pollution which will eventually make its way into the local water supply. This can damage the local ecosystem and contaminate the water supply but can also cause problems beyond the scope of the local community if this water supply is part of a greater watershed, such as the large Chesapeake Bay watershed.

Introduction

Given the common occurrence of heavy storms along the mid-Atlantic region, many citizens are already aware of the issue at hand. Many communities, especially those near the water, provide public knowledge about stormwater and the watershed. These communities know, for the most part, about how stormwater runoff can pollute the environment and the Chesapeake Bay. This is done through various forms of presentation, such as educational websites, PSA's, and educational programs in schools. Some schools in the region offer magnet programs that focus on environmental science and sustainability. The sociopolitical issue at hand, however, is the lack of cooperation between governing bodies and the local community. This is the issue discussed as part of the team's vision statement. This paper aims to use STS principles and frameworks to analyze the different forms of community outreach to communicate proper stormwater management procedures and to facilitate positive communication between the government and residents about stormwater issues. With this insight, the team can come up with a proper method to better facilitate the conversation around stormwater management between the community and the government.

Literature Review

There already exists many stormwater management educational programs not just in Hampton Roads, but across the United States. In implementing a potential stormwater outreach or educational mission, the team could take insight from some of these existing outreach programs. A report by David Woods (2017) lays out such an approach in the case of pet waste. Woods lays out four steps to create an outreach program that can easily be followed once there is a defined goal: ask for commitment, establish "behavior prompts" at specific locations, communicate the norm, and

remove barriers (Woods, 2017). The report considers some general STS principles and, though there is no defined framework, it should not be difficult to adapt the results of the report to incorporate STS frameworks. In another report, Catherine Neisender and Robin Shepard (2010) discuss the importance of education when it comes to stormwater management. They review stormwater management programs that "...elevate the importance of education to the same level of importance as the engineering, modeling and monitoring work that must also go into development of a stormwater plan." (Neisender and Shepard, 2010). The report also mentions the importance of public participation when it comes to supporting, funding, and implementing stormwater infrastructure, citing a process in Dane County, WI, where public participation helped the process run smoothly (Neisender and Shepard, 2010). While the programs covered in this report are for the Great Lakes region, the team can nonetheless gain insight into creating successful outreach programs for the Chesapeake Bay watershed region.

The process of analysing the stormwater outreach programs could take some influence from the paper by Madsen, et al. (2017). The paper uses the Social Construction of Technology (SCOT) framework to analyze existing stormwater control measures in Melbourne and Copenhagen. In particular, they propose a conceptual framework that shows the evolution of new technologies up to their acceptance by the consumers (Madsen, et al, 2017). This can be used to analyze existing technologies, and in this case, various outreach programs. The SCOT analysis done by the paper can also be applied to an analysis of how the community reacts to outreach programs.

Framework

Following the general idea of the paper by Madsen, et al, (2017), we will use Social Construction of Technology (SCOT) to analyze stormwater educational and outreach programs. We will consider our relevant social groups as government officials, subject experts, community members, educators, and youth. SCOT is being used to see which of these groups are represented in existing outreach programs and if so, then any similar outreach programs in the future should consider them as well. Obviously, not every outreach program would apply to every group. Educational programs within schools will target educators and youth more than other community members, for example.

Bibliography

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