Detail Project Plan

Lam Chun Ho 3035685184

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Supervisor: Dr. Choi, Yi King
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1 Background

1.1 School Assessments

Nowadays, students can easily access many online resources and tutorials like StackOverflow, Reddit, GitHub, and more. They can easily find solutions to problems they have when learning. Indeed, these websites sometimes give a full-rounded explanation of solutions. Students can copy the answers with the highest up-votes for answers without effort. However, most of the answers are just briefly mentioned or even incorrect. When it comes to school assessments, finishing homework and exams is always what students want. The materials and scope of the courses are sometimes similar to previous years. Tutors may design the assignments that reference the internet. Students can also seek resources from seniors. These resources are always helpful to them. As a result, students may copy a workable solution to the questions from these resources without effort because of the online or senior resources.

1.2 Course-based Moodle Forums

In HKU, students may ask questions in Moodle forums when working on the assessments and revising exam contents. However, others with similar or identical problems may think they understand correctly after reading the answers. However, it is not in reality sometimes. Along with this, most Computer Science course forums have very few discussions. Teachers are the most frequent respondent to the questions in the forum. Students tend to use internet solutions that solve the problems in assessments simply. For example, questions about dynamic programming may be similar to questions on LeetCode. Students may copy the answers from the discussion without understanding them and interacting with others. Therefore, students may not learn knowledge clearly.

1.3 Overseas Forums and Hong Kong Forums

It is easy to find overseas discussion forums on Computer Science. There are specific forums for discussing different categories. For example, users can find solutions on coding in StackOverflow, mathematics problems in Mathematics Stack Exchange, and Computer Science problems on Computer Science Stack Exchange. In China, many forums are in mixed languages, English and their native language, which helps local users to learn. These overseas forums even have active discussions about job seeking, ranging from start-ups to famous companies.

In contrast to the above, Hong Kong has large-scale forums like HKGolden, HK discuss forum, and LIHKG. Hong Kong citizens who understand English may also visit Reddit, and StackOverflow, for example. Hong Kong citizens also actively use Facebook, Instagram, and Discord. However, there are few discussions about Computer Science knowledge compared to overseas forums. Statistics in StackOverflow 2021 developer servery have shown that Hong Kong only has 0.24% in the Geography category, which is small compared to China (1.27%) and France (3.25%) [7]. Compared to overseas, Hong Kong does not have a large-scale and separate discussion forum on Computer Science.
1.4 Problem Statement

Students may fail to understand the materials and acquire the answers from the websites without effort in such an unmotivated environment. These websites may engage students in copying and crowd-sourcing with others, which also weakens their independent thinking and motivation for learning. Along with the above problem, students may be weak in future programming works and interviews after graduation. As mentioned before, heavily relying on online sources may decline their independent thinking, and they may need more time to understand the knowledge after graduation. Students will be less competitive than others in famous companies like Meta, Google, Microsoft, and Amazon, because they do not clearly understand the materials.

Furthermore, the learning environment in Computer Science is unmotivated and inactive. Compared to overseas forums, Hong Kong forums do not have a stable, scaled discussion forum for students to discuss Computer Science knowledge. LeetCode even provides different self-learning courses for users. Programmers in China even localized some terms that help other users to learn. Hong Kong students may lack participation in learning algorithms because of their proficiency in English which makes them understand the contents. However, they may lack interaction with others which confuses understanding of their knowledge.

2 Literature Review

2.1 E-learning and Gamification

E-learning is a method for students to learn everywhere and every time within the time limit, which gain higher control and freedom over their learning progress [3]. According to Amriani et al. [1], e-learning should be a tool to encourage participation in the traditional class environment and for students to learn actively.

Gamification is an idea that transforms non-game contexts to game elements [4],[6]. Existing examples are Nike+ Run Club, eBay, and Todoist. These examples used gamification to produce motivations and connections between customers and the company [4]. There are some implementations of gamification in education; a famous language learning app DuoLingo also implemented gamification. Research [1]-[3],[5]-[6] also add gamification designs and strategies to the e-learning environment to examine the effects on motivating the learning environment, their performances, participation, and more. Students will gain more motivation and engagement with the given missions by combining gamification and e-learning [1].

2.2 Design Principles for Gamification

Game elements are taking an important role in gamification. There are common game elements, including feedback, goals, badges, points, a leaderboard, and a level system [1]-[4], [5]-[6, Sec. 1] that follows the three aspects of gamification design[4] (see Appendix A.1). The application should also integrate with classes and courses in education. For example, see [1]-[3],[5]-[6, Ch. 4, pp. 53-78]. Gamification implementations should also consider the self-determination theory [1],[5] (see Appendix A.2) because of its emphasis on their goals.
2.3 Implementations on Gamification

Some researchers implemented gamification in e-learning in Moodle. For example [1],[3],[5]-[6, Ch. 11, pp. 238-260] modified Moodle and applied different game elements into it. There was also an implementation called PeerSpace that provides a collaborative learning environment that includes functions with online social networks [2].

2.4 Gamification Experiments

According to Poondej et al. [3], adding gamification strategies should be considered to motivate and engage students in learning. Most students in the gamification group had positive feedback on gamified education compared to the traditional education group[1]-[3],[5]. The gamification group had higher motivations than the control group [2],[3]. However, Amriani et al. [1] suggested that gamification does not imply an obvious effect on students’ participation but on their performance. The class materials had higher downloads where the experimental group had an average of 89 total downloads per week compared to the control group had an average of 65 total downloads per week [5]. The experimental group in [6, Ch. 7, pp. 131-151] had an obviously better academic performance than the control group, and the two groups had a similar score on motivational beliefs. Experiments [1]-[3],[5],[6, Sec. 2] showed that gamified environments may gain positive effects, including motivation for learning and participating, and may also improve academic preferences. That implied the positive influence of gamified e-learning, including better academic results and higher motivation for learning.

3 Objectives

3.1 Motivation in CS E-learning Environment

Overall, this project will create a website and achieve the following objectives for university education, where programming is the main topic in the project. Students can gain motivation to learn Computer Science through gamification strategies. They can learn from discussion, thinking, and contributing to the e-learning environment. As a result, students can learn and reinforce their knowledge for preparing for future interviews and careers.

3.2 Knowledge Sharing and Learning

The website will provide different game elements for students to learn. Students can strike for a higher position on the leaderboard, more badges, and points by completing various content on the website. Users will feel challenged after interacted with the system [4]. Students can gain a better understanding of knowledge about Computer Science in the end. Students can exchange their knowledge, experience, and ideas with others [2] in the forum. With a motivated environment, students can foster their abilities to learn with interaction and to think independently.

Moreover, students and teachers will periodically get feedback. For example, the website will provide reports or statistics for the department at the end of a game, user
progress on different courses, and user statistics on their profile. As a result, students and teachers can track on their statistics for getting better understanding to themselves.

4 Approach & Methodology

4.1 Game Elements

This project follows the design principles of gamification and some implementation of research. Users can post discussions and questions in the forum. Users can also finish the competitions, challenges, and courses. They can get points and badges for leveling and climbing up the leaderboard by these actions. Users can get feedback on their learning progress. There are different feedback. Simple feedback like “It is correct.”, “It is incorrect”, and some hints. Feedbacks like gaining points and climbing up the leaderboard are the feedback by gamification. Table 1 explains the plan of game elements that the website will have.

<table>
<thead>
<tr>
<th>Leaderboard</th>
<th>Ranking system will be implemented. Users can view their position on contests, levels, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point system</td>
<td>Users will gain points for their actions on the page. For example, gain some points after finishing the context, challenges, etc.</td>
</tr>
<tr>
<td>Level system</td>
<td>Users will have a numerical level based on their points.</td>
</tr>
<tr>
<td>Badges</td>
<td>There will be badges for users when they make progresses on the courses, finish the contests and challenges, etc.</td>
</tr>
<tr>
<td>Courses</td>
<td>There will be 2 courses for users to learn in these six months. Users will get points for each finished section, and view the progress of the course. Each courses will have 3 sections.</td>
</tr>
<tr>
<td>Contests</td>
<td>There will be a demo contest for students to join. Users will get points after finishing the contest.</td>
</tr>
<tr>
<td>Challenges</td>
<td>There will be 2 challenges for other users to solve. They will get points after finishing the challenges.</td>
</tr>
<tr>
<td>Feedback</td>
<td>Users can know their progress on the courses by progress bars. They can also know the grow of their performance.</td>
</tr>
<tr>
<td>Forum</td>
<td>Users can post discussions and questions, they will gain points and badges by posting good questions and discussions.</td>
</tr>
</tbody>
</table>

Table 1: The details of the game elements to be developed.

4.2 Development Details

This project will use various technologies, and tools in development. Table 2 explains the details of technologies and tools. This project uses a common code editor Visual Studio Code (VS Code) with developing the website in MacOs and Windows. All source code is pushed to GitLab for code management. Figure 1 shows the flow of the development. After there are components and pages available, this project uses Next.js for developing the website. There are different pages on the website including the forum, contests, challenges, and user pages. Each page has its sub-pages like posting questions in the forum.
There are forum, contests, courses, points, and leveling systems on the website. The back-end of the project is to develop the systems and the API between Next.js and Strapi. To simplify the complexity of development, this project uses Strapi as the Content Management System. The Next.js framework requests data from Strapi and the API is tested by Thunder Client, which is a Visual Studio Code extension. This project deploys the Strapi to Heroku, and Strapi uses Postgresql as the database management system.

<table>
<thead>
<tr>
<th>VS Code</th>
<th>Code editor.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GitLab</td>
<td>Source code management.</td>
</tr>
<tr>
<td>Figma</td>
<td>Website design tools.</td>
</tr>
<tr>
<td>Next.js</td>
<td>React Framework for developing website.</td>
</tr>
<tr>
<td>Thunder Client</td>
<td>Extensions in VS Code for testing API.</td>
</tr>
<tr>
<td>Strapi</td>
<td>Open source Content Management System.</td>
</tr>
</tbody>
</table>

Table 2: The details of the development.

5 Project Scope

5.1 Scope

Given that there are many topics in Computer Science and time limits, the project will focus on Programming because it is an essential element in future career and academic learning.

Along with this, this project will design a gamified website based on findings in other research, where it focuses on learning to program and motivating the learning environment. The website will not be for a single course but for all Computer Science students in a university to use it. This project will also not include AI or ML functions.
5.2 Exclusions and Challenges

This project will not include research on AI or ML but may implement functions with AI or ML. Besides, this project will not collect real-life data and research the effectiveness of the design.

Given the time limit, the website may not contain too attractive designs on layout and all functionalities. This project may not develop some functions (for example, the chatting system [2]).

5.3 Deliverables

Deliverables for the project will include a website that implements the gamification based on the research, a project webpage, two presentations, an interim report, and a final report.

6 Schedule

Figure 2 indicated the timeline of the project. The following are the details of timeline.

6.1 Semester 1

This semester will focus on two parts, design and development. This project will implement the functionalities based on other research and different websites (for example, LeetCode, Reddit, and StackOverflow). Along with this, this project will design the database schema and pages. This project will continuously develop and integrate the front-end and back-end after this project designed some pages and components. At the end of semester 1, this project plans to implement half of the website.

![Figure 2: Proposed timeline of development](image-url)
6.2 Semester 2

This semester will focus on development. At the beginning of the semester, this project will deliver an interim report with a presentation. This project will continuously develop the remaining parts of the website. Same as semester 1, this project will continuously develop and integrate the front-end and back-end from the design. After that, this project will handle the optimizations and documents. At the end of semester 2, this project plans to implement the remaining part of the website and deliver the final report with a presentation.

7 Conclusion

The above described the background of the project. The literature review mentioned different implementations and principles of gamification that also showed the feasibility of the gamification approach. The main objective is to motivate students in the Computer Science e-learning environment and to foster their abilities to think independently and to learn through interactions. This document also mentioned the approaches, schedule, and scope of this project with the prerequisites and risks.
References


Appendices

A.1 Three Sections of gamification design

• **Mechanics**: Points and badges that concern data representation and algorithms. [4]

• **Dynamics**: Players’ inputs and outputs over time are concerns of the runtime behavior of mechanics like completion and choices. [4]

• **Aesthetics**: Users’ emotional responses after they interact with the gamified system. For example, the feeling of being challenged. [4]

A.2 Self-determination theory

• **Relatedness**: Interactions and connections with others, their goals, their interests. [1],[5]

• **Competence**: Challenging tasks aiming to complete their goals are what personal interests in. [1],[5]

• **Autonomy**: This satisfies the need to control one’s own life by taking part in the voluntary play to fulfill a person’s individual goals. [1],[5]