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The use of coding competitions as a learning motivation for programming students in Higher Education

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ABSTRACT

Coding competitions have become a powerful pedagogical tool to enhance student engagement and motivation in higher education programming courses. These competitions provide a dynamic learning environment that encourages problem-solving, critical thinking, and collaboration among students. This paper reports on the results of an annual coding competition for undergraduate students at the National University of Samoa and discussed its achieved results. The initiative started in 2020 when an increased number of students took programming courses. There were a lot of challenges in teaching programming [1] and this approach was used as a learning motivation for students. From the observations of the first ever competition, students demonstrated motivation in learning programming and show great improvement with their programming skills in class. Students also reported the positive impact of the competition on them; it has inspired them to learn effectively and help them to achieve better results in their programming classes.

Key words : coding competitions, programming, higher education, java programming

1. INTRODUCTION

Programming teachers have been looking for solutions to combat issues and difficulties in teaching computer programming [2]. Its not an easy task [3] and one of the biggest challenges in computer sciences [4] Programming students also find it hard to study programming, especially novice learners in university [5]. Computer programming courses are one of the crucial subjects offered in the curricula of numerous universities [6]. It's an essential skill that must be mastered by anyone interested in studying computer science [7]. Programming courses are the major components for the Bachelor of Computer Studies program offered at the university ranging from 100 levels to 300 level courses. The entry level to the introductory programming course is a pass in Foundation English and Foundation Mathematics course. Previous studies revealed Yr 13 Maths, English, and Computer Studies as strong predictive factors for Foundation Computer studies [8] where there is programming component. According to most of the lecturer's assessments, most students ignore the programming component as it seems difficult for them. The challenge of maintaining consistent motivation among programming students in higher education has emerged as a significant concern. While programming skills are increasingly vital in the technology-driven world, educators often grapple with students' lack of engagement and perseverance in mastering such skills. This research problem underscores the importance of identifying effective strategies to cultivate and sustain motivation within the programming curriculum. Since then, the teaching staff have investigated solutions and relevant approaches to help and motivate students. Research has explored various motivational techniques, such as gamified learning environments, peer collaboration, and project-based assignments, which have shown promise in engaging students [9][10]. However, coding competitions—a unique blend of challenge, collaboration, and real-world problem-solving—remain an underutilized method in programming education despite their potential to spark enthusiasm and inspire excellence.

The purpose of this study is to investigate how coding competitions can be effectively used as a motivational tool for programming students in higher education. Specifically, it aims to evaluate the influence of competitions on students' engagement levels, learning outcomes, and long-term interest in the subject. To achieve this purpose the study adopts a quantitative method research design to capture student's perspectives on the coding competition experience. In the year 2020, a first ever coding competition was introduced to the third-year students and it was a successful event.

Students were eager to look for sponsorships to help with the prizes, uniforms and refreshments. The competition continued over the following years because of its successful results.

2. LITERATURE REVIEW

The study draws from foundational educational theories that address motivation and learning:

Self-Determination Theory (SDT): Developed by Deci and Ryan, SDT emphasizes intrinsic and extrinsic motivation as key drivers of behavior. Coding competitions align with these principles by fostering intrinsic motivation through problem-solving and extrinsic motivation via rewards like recognition or career prospects. [11][12]

Expectancy-Value Theory (EVT): EVT posits that students' motivation is shaped by their expectations of success and the value they place on an activity. Coding competitions hold significant value in programming education by simulating real-world challenges and enhancing employability.[13]

Several concepts and models underpin the use of coding competitions in education:

Gamification: Coding competitions incorporate elements such as leaderboards, timed challenges, and collaborative teamwork, which are hallmarks of gamified learning environments. Studies on gamification in programming education[14] have shown increased engagement and satisfaction among students, though critiques highlight the potential stress and anxiety linked to overemphasis on competitive aspects. [13]

Experiential Learning: Kolb's experiential learning model emphasizes learning through concrete experiences followed by reflection. Coding competitions provide hands-on, practical problem-solving scenarios that facilitate experiential learning, though some argue that such events may lack sufficient reflection, leaving theoretical understanding underdeveloped. [13]

Research specifically focusing on coding competitions remains a growing field, but several key studies have emerged:

Effects on Student Motivation: Studies by Smiderle, R., Rigo, S.J., Marques, L.B. et al. examined the impact of coding competitions on student engagement and learning outcomes. Findings suggest that participants demonstrate higher motivation and performance compared to non-participants.[10]. However, these studies often lack longitudinal data to assess sustained motivation over time. [13]

Skill Development and Collaboration: Research has also highlighted the potential of competitions to enhance collaboration, critical thinking, and technical skills. For instance, shared problem-solving during competitions fosters peer learning, though critiques argue that such formats might disadvantage students who are less experienced or confident. [13]

Integration in Curriculum: While some studies advocate for integrating coding competitions into programming courses, concerns remain regarding accessibility and inclusion. Limited research examines how socio-economic factors or prior experience might create disparities in competition participation and outcomes.

Although existing research underscores the benefits of coding competitions, several gaps warrant further investigation:

- The long-term impact of coding competitions on student motivation and career trajectories remains underexplored. [13]
- Limited focus on how coding competitions affect students from diverse backgrounds, including those with varying skill levels or socio-economic constraints, leaves questions of equity unaddressed. [13]
- Few studies provide comprehensive frameworks for incorporating coding competitions seamlessly into higher education curricula without overburdening instructors or students. [13]

3. METHODOLOGY

This study uses a quantity approach to determine the impact of programming competitions on students' learning motivation. Quantitative methods are particularly useful for measuring relationships and trends through statistical analysis [15].

The target population consists of undergraduate programming students from the HCS381 class. A sample size of 15 students is determined as only 13 from the class participated based on guidelines for quantitative research sample adequacy [16]. The coding competition was based on how fast students can solve programming problems. There were 3 rounds and from each round the best students were selected until there were 3 students to compete for the top 3 prizes. Prizes were sponsored by different ministries and organizations. After the competitions students were given a feedback questionnaire.

An online questionnaire was developed as the primary data collection tool. The questionnaire consists of questions as shown in Figure 1 and Figure 2.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Not Applicable
The coding problems were easy	○	○	○	○	○	○
The concepts were covered in the class	○	○	○	○	○	○
There was enough time for each round	○	○	○	○	○	○
I got the output as expected	○	○	○	○	○	○
I enjoyed the competition	○	○	○	○	○	○
The competition motivated me	○	○	○	○	○	○
I recommend this competition again next year	○	○	○	○	○	○

Figure 1 : Likert Scale questionnaire

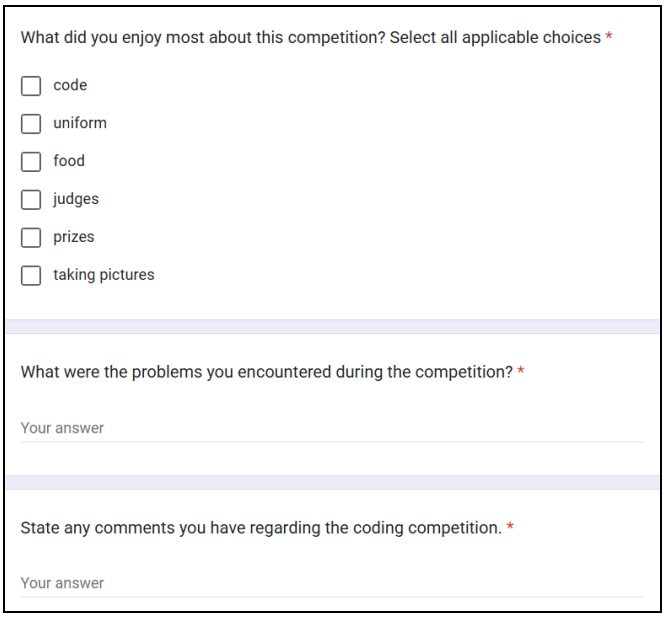

Figure 2: Open ended questionnaire

4. RESULTS AND ANALYSIS

The results were analyzed on Microsoft Excel since only 12 students participated in the survey out of 15 students that competed. Figure 3 demonstrates the responses to Figure 1.

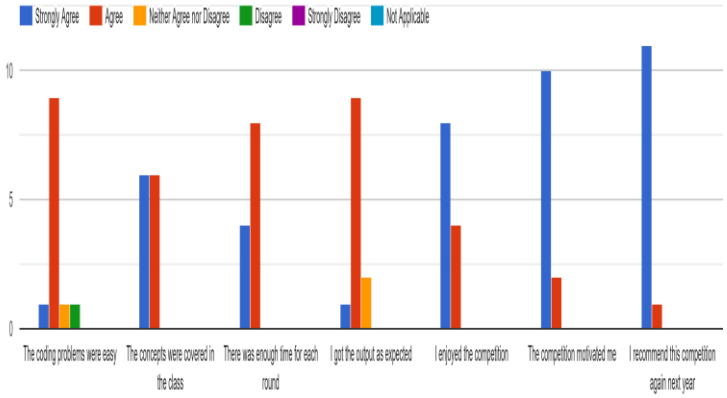

Figure 3: Results 1

Most students agree that the problems were easy. No one disagrees with the fact that the concepts used were covered during classes. Everyone agreed that there was enough time during the competition and mostly agreed to receive the expected output of the program. Everyone enjoyed the competition, motivated and agreed to have this competition again.
This shows the impact of the competition on students experience and how they respond that this should be continue on in the future.

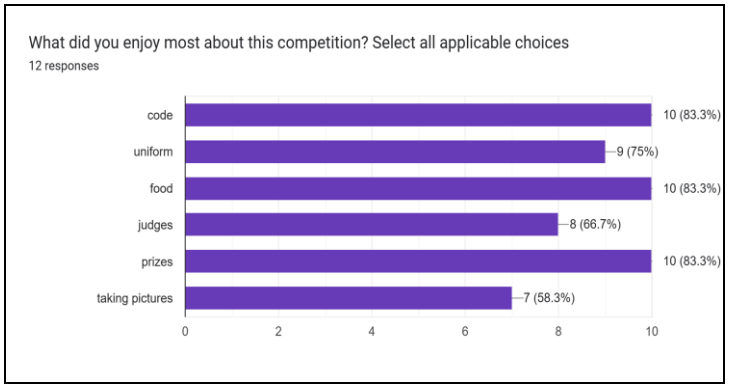

Figure 4: Results 2

Figure 4 shows that the students enjoyed the coding, uniforms, food and the prizes. The prizes were also something that motivated them to do better in the competition.
When asked regarding any problems they encountered. No one had any problems except for a few who had technical problems with their computers. One student responded that it was a great initiative and overall, an awesome experience despite technical problems. Some of the best comments made from the students were:

Student1: "*Highly recommend the continuation of this activity(competition)over the years for it helps boost up the programming skills of the students as well as coordination amongst the peers during the time of preparation*".

Student 2*: "It's a good competition that will help motivate and foster competitive drive and an interest in coding"*

Student 3*: "Great opportunity to test the skills of students, speaking for myself, to look at where in the course I am at and how Ive gained so far"*

Student 4: *"It's a very interesting competition and it motivated me so much to study more about programming"*

Student 5: *"such a good motivation for coding students".*

Student 6: "*It is a great opportunity for programming students to use knowledge gain from learning java in class".*

This shows positive feedback on how the coding competition motivated them in the field of programming.
Limitations may be the number of respondents, and students might be bias with their answers.

5. CONCLUSION

The study shows that students were successfully engaged in the coding competition, revealing the high level of motivation in them to boost their programming skills. The results strongly support the initiative and recommend the continuation of such

competition. The competition became an annual event since the 2021 til 2023 as students continue to have interest on the coding competition. People from the community were also interested and supported this coding competition by sponsoring the prizes, uniforms and food for the event. Coding competitions are indeed effective to be used as a motivational tool for programming students in higher education.

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