Gamification and the future of robotics education

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Abstract—**This Paper aims to explain the advantages of using gamification in different classroom settings.**

Keywords—gamification, classroom modification, gamified education

I. Introduction

Education is widely regarded as one of the most critical factors in the development and progression of societies. This is the reason why it is crucial to choose a system that encourages active learning and participation for the sake of understanding as opposed to a system that encourages learning for the sake of memorization.

This paper aims to cover two different learning systems: the learning hub (a system akin to the university system, where students receive modular tasks with deadlines and the freedom to choose when to complete their tasks) and a game competition system (a system where instead of having multiple smaller tasks, students work the entire time on one big project).

The Subject we have chosen to conduct this experiment is System Engineering with the support of Prof. Roland Strohmer, and we have replaced the Modules 'Basics of Sensorics', 'Using Sensors with Actuators' and 'Using advanced Controllers' with Participation in the ECER Competition in 2025 in the Botball division. To ensure that the students participating in the experiment do not fall behind the students in the learning hub system, we have chosen a group of four students to study the modules in the learning hub system, henceforth referred to as Group A, and the test group participating in the Botball Competition, henceforth referred to as Group B.

As the ECER Competition has not occurred as of the writing of this paper, we have chosen to determine the results by two written, automatically graded tests designed by Prof. Strohmer, one of which having been taken before the beginning of the experiment (in early December of 2024) and one having been taken a month before the competition (late February 2025). The first of these tests covered the topics learned in the first semester to establish a baseline, the second test covered the topics of the Modules we aimed to replace.

We have found that on the first test group A and group B started with an almost equal baseline, having on average only a difference of 0.3 points, while on the second test group B had on average 1.4 points more than group A, thus showing understanding of the topic in both groups, with further research into the topic being required for definite results.

II. State of the art

Many people have already come up with concepts for how to improve learning environments and how to design education systems.

Pineros (2023) conducted a study looking into using gamification as motivation for medical students, particularly looking into using it to increase the amount of time students spend engaging with the material. [1]

Gabhan & Hendley (2019) conducted a study looking into how different personalities interact with an educational environment using gamification. [2]

Schedler (2020) looked into using gamification in schools as a tool in the existing system instead of an entirely new system. [3]

III. CONCEPT

Our goal with this experiment was to compare two different systems of learning with a focus on independent learning and gamification. We compared the learning hub system, which splits the entire curriculum for a semester into smaller modules, which each cover one subtopic of the curriculum that every student has to complete independently within a given timeframe, where the responsibility of completing all tasks in time is placed on the student, with our concept of a competition system, in which there is one big competition that requires students to build or develop something that covers all topics of the curriculum, with one deadline of the competition, where the responsibility of achieving a good score at the competition is placed on the student (or team of students, depending on the implementation). Both systems aim to improve the independence, self-responsibility and technical knowledge of students.

The reason we want to compare these systems is to see if the drive to compete against other students improves the speed and thoroughness of acquiring knowledge with students, or if due to the nature of there being only one big tasks, students will feel overwhelmed and struggle with completing the entire task. We have chosen not to compare our experiment against a typical classroom setting (where the responsibility of timing the curriculum is placed on the teacher) in order to more accurately compare the many small tasks vs one big task concept, as this way both groups of students have the same basic responsibilities of finishing the entire curriculum on their own time, and being responsible for the timing of their learning.

IV. Implementation

As both the Competition for Group B and the Deadline for Group A have not yet happened as of the writing of this paper, we have chosen another method of comparing the results of both Groups. In order to achieve this, we have had both groups take two tests, one test in early December of 2024 to establish a baseline of the curriculum in the first semester, as well as a second test in late February of 2025, with which we have compared our results.

With the first test we did, we found that both Groups had a nearly equal Average (*see Figure 1*) of 8.215 and 7.995 Points out of 10 respectively.
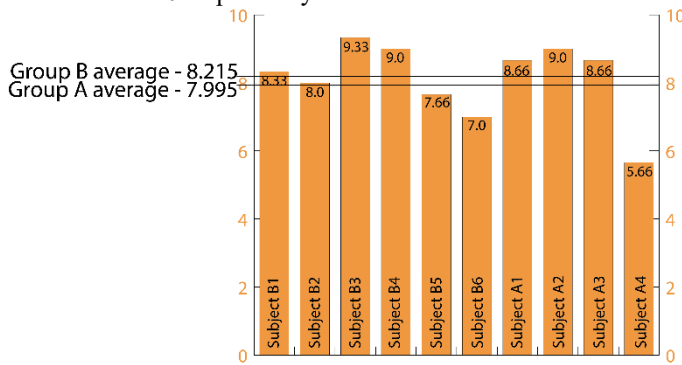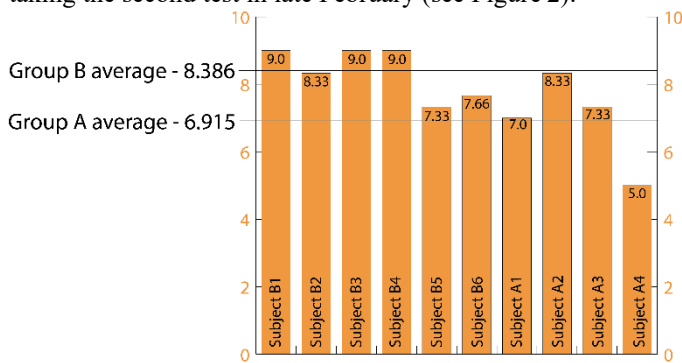

Figure 1 Results of the first test

We then let both Groups learn in their respective Systems, taking the second test in late February (see Figure 2).

As we have found with the second test, Group B scored on average 1.4 Points above Group A, suggesting a better understanding of the curriculum in Group B.

These Results are quite obviously not very conclusive, as we are working with a very small sample size for such an experiment and the conditions are quite different for different subjects and competitions, not to mention that we had to account for different team sizes due to the learning hub system being designed for independent, individual work, not necessarily group projects. We accounted for this issue by taking multiple students who worked independently as comparisons, to balance out the variances within Group B.

V. Conclusion

We have found that while both groups were learning exactly the same curriculum, Group A on average scored 1.4 points out of ten less than Group B. We do not believe this to be sufficient evidence of our concept to be better than the learning hub system, but it would appear that the project system at least matches the existing system, or at the very least that further study into this topic would be justified.

References

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