

WIP: SEmi-Automated Second-order Incentive Driven Engagement of College Students

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Abstract— This innovative practice WIP paper introduces a new method, which we call SEASIDE: SEmi-Automated Second-order Incentive-Driven Engagement to improve class attendance and participation of college students. Class attendance significantly impacts college students' academic success and personal development. To combat low participation, educators have tried various methods, however, these approaches often bring administrative challenges and need to accommodate students with disabilities. Our proposed strategy, SEASIDE, employs a mostly hands-off automated system with indirect rewards that do not alter grades in a straightforward fashion but offer benefits like assignment extensions or flexible exam options, which can potentially influence course grades. Implemented in an introductory Embedded Systems course with 240 students, this system allows students to trade participation points for assignment extensions, addressing common issues like procrastination and unexpected personal challenges. Our findings indicate that nearly 75% reported that these incentives motivated regular attendance and active participation. This approach not only enhances student engagement without directly impacting grades but also simplifies administrative processes for educators.

Keywords— attendance, incentive, participation, large class, automation

I. INTRODUCTION

The importance of class attendance for college students is multifaceted, offering a range of benefits that significantly contribute to their overall academic success and personal development. Attendance and active class participation is linked with a deeper understanding of the subject matter. Furthermore, attendance fosters meaningful interactions with professors and classmates, leading to mentorship opportunities and the formation of study groups, both crucial for academic and personal development. To enhance attendance and participation in college classes, educators have employed various strategies that blend technology, psychology, and pedagogy. In this paper, we provide a short overview of the most prominent techniques to improve class attendance and participation. We also discuss the shortcomings of these strategies and explain why they are rarely widely adopted.

We then introduce our SEmi-Automated Second-Order Incentive Driven Engagement (SEASIDE) approach. This method integrates typical class activities with rewards that influence course grades but not in a direct way. The system enables students to accumulate points via online real-time class quizzes. These points can then be exchanged for perks such as extended deadlines for assignments, a reduced version of the final exam, or favorable methods of calculating course grades. In addition to improving class participation, the method is crafted to reduce the administrative burden on educators. The innovations associated with this work are two folds:

- **Innovation in incentives:** The previous techniques have looked at the incentives as black and white. They have either focused on directly manipulating the grade based on attendance and participation or moved away from it completely by introducing badges, scoreboards, etc., which have nothing to do with the course grade. In this paper, we introduce second-order incentives: perks that can potentially affect the course grade and many students are highly interested in them.

- **Innovation in automation:** We have used a widely available Google platform to automatically collect and process students' participation points. Turning points to rewards and deducting them once the students "spend" their points are also automated. With this, we have turned a burdensome activity which typically discourages instructors and students to implement class activities into a fun and approachable task.

II. PRIOR WORK

To enhance class attendance and participation in colleges, educators have implemented a variety of techniques. These techniques combine technology, psychology, and pedagogy to create more engaging and effective learning environments.

A. Making classrooms more interesting

Flipped classrooms [1], where students review lecture materials in advance and engage in hands-on activities in class, encourage active participation and attendance. Another strategy is guest lectures [2] and interdisciplinary collaboration, which introduce new perspectives and keep the curriculum dynamic

and interesting. Although very impactful, these methods are not easy to implement. For example, the flipped classroom requires complete restructuring of the lecture material. Furthermore, some courses do not have the opportunity to use guest lecturers to make the classroom lecture more interesting.

B. Offering participation grade

Offering participation grades as a component of the course grade has proven effective in motivating students to attend and engage in class discussions [3]. While offering participation grades as a component of the course grade can be a motivational tool in educational settings, it also comes with notable drawbacks. One significant issue is the influx of requests from students seeking excuses for their absences, which can become particularly cumbersome in large classes. This not only adds to the administrative burden for instructors but can also lead to inconsistencies and perceived unfairness in how excuses are granted or denied. Additionally, the mere presence of students in the classroom does not guarantee their engagement. Many students, knowing that attendance contributes to their grade, may physically attend while mentally disengaging. This challenge undermines the true intent of participation grades, which is to encourage active and meaningful engagement in the learning process, rather than just physical attendance.

C. Gamification

Gamification in education, particularly in college settings, refers to the application of game-design elements and principles in non-game contexts to improve student engagement, motivation, and participation [4]. Here are some examples of how gamification is used in college classrooms:

1) Points System: Like scoring points in games, students can earn points for activities like attending classes and participating in discussions. These points can be tracked and often contribute to their course grade. These methods although more interesting when compared to the method discussed in Section II.B, it still suffers from possible superficial student participation.

2) Badges and Achievements: Incentives in the form of digital badges or certificates can be awarded for accomplishments, such as perfect attendance, or exceptional class participation. These badges serve as tangible tokens of achievement and can be very motivating. However, for most students, earning badges and certificates that do not affect the final grade might not incentivize class participation for many of the students.

D. Using real-time participation activities

One popular approach is the incorporation of interactive technologies, such as online quizzes and forums, online polls using clickers, etc. which engage students and facilitate real-time feedback [5]. Our approach builds upon the prior work in this area. These interactive activities fall into two categories depending on how they affect student grade:

1) Without effect on grades: If the students do not receive grades for their participation in these activities, they might have no incentive to participate. Even if they are physically present in class, they find it difficult to switch from whatever they are doing in the class to engage in the activity.

2) With effect on grades: If the students receive grades for participation, the activity turns into what is technically considered an “assessment.” This creates a whole set of new challenges, especially as it relates to *students with disabilities* who need extra time or a quiet room to complete assessments. Even students without disabilities might feel stressed out while taking part in the activities as they resemble a “pop quiz.” This will not have a positive effect on students’ learning and can result in excessive administrative work to help students with disabilities to participate. Our approach finds a compromise between these two categories where the students receive meaningful reward for participation but it sidesteps the issue of turning the real-time class activities into mini assessments using second-order incentives.

III. OUR PROPOSED TECHNIQUE: SEASIDE

We propose to combine real-time class activities with a reward system that uses second-order incentives. Like some of existing techniques, students participate in class by completing online quizzes. They collect up to one point per lecture depending on the number of correct answers to the questions posted throughout the lecture on that day. The innovation in our approach comes from what we use as incentive for the students. Instead of incentives that directly affect the course grade or the incentives that do not affect the course grade at all, we use a different set of incentives that we call second-order incentives. These are incentives that do not affect the grade directly but affect other factors that can affect the course grade. A few examples of such incentives are described in detail in the following sections.

A. Trading points for extensions

In addition to usual procrastination, most students face unexpected circumstances once or twice during the semester that makes it hard for them to complete the assignments on time. Documenting these circumstances and getting official extension from the Dean of Students is extremely time-consuming for most situations and not possible at all for some incidents. Many students wish to discuss their situation with the instructor and get an extension directly from the instructor. Nevertheless, the instructors lack the administrative resources and enough information to make fair and informed decisions for granting extensions. For all these reasons, extension for an assignment is a commodity that many students are highly interested in, and instructors face many requests that need processing. In our proposed system, the student can trade their points for extensions on the assignments. In ECE2564, where we implemented this system, there are three projects and 12 homework assignments. We estimated that perfect class participation results in almost 35 points for a student because there are about 35 non-exam class meetings. We “priced” a day of extension for the projects at 7 points and a day of extension for homework assignments at 5 points. Furthermore, we capped the number of extension days for a given assignment to three days.

The graders submit a simple google form for each student with late submissions which deducts the points from the

student for the extension and returns with either a success or failure depending on if the student has enough points for the number of late days. Upon the implementation of the above system, the number of requests for extension dropped to zero. In other words, students used the reward system to get an extension instead of approaching the instructor to validate an excused extension.

B. Flexible final exam for students with high cumulative points

Another highly coveted commodity by students is a final exam where some of the topics are dropped as opposed to a fully cumulative final exam. In one version of our implementation, students who have 90% or more in their participation points took the non-cumulative final exam.

C. Dropping lowest grades in different categories

Although we did not explore these incentives in our implementation, we envision several other second-order incentives. One example could be to provide more flexibility for students who have high participation points when calculating the course grade. For example, by trading 15 points, a student can get the lowest homework assignment to be dropped from their course grade.

IV. STUDENT PERCEPTION

At the end of the semester for a class of 240 people, we asked the students to express how much they either agree or disagree with six (6) statements listed in Table I. Fig. 1 presents the percentage of students at a certain agreement level for a given statement. For example, 30% of the students strongly disagree with the Statement #1, while 43% of the students strongly agree with Statement #2.

TABLE I. STATEMENTS

#1	Collecting participation points does not motivate me in any way.
#2	Trading participation points for extensions on assignments motivates me to come to class more often.
#3	Having enough participation points that allows me to skip the cumulative final exam motivates me to come to class more often
#4	Participation activities are a useful teaching technique regardless of the reward system. They help me understand the course material.
#5	Participation activities help me connect with my fellow classmates in a positive way.
#6	I have realized a flaw or shortcoming in my understanding of the lecture material when I tried to complete a participation quiz.

Our survey results show that students find the second-order incentives especially the noncumulative exam option, highly motivating for class attendance. We also observe that 42% of the students believe the class activities help them connect with fellow students in a meaningful way. Furthermore, 66% of the students agree with the statement that the class activities have resolved a flaw in their understanding of the material.

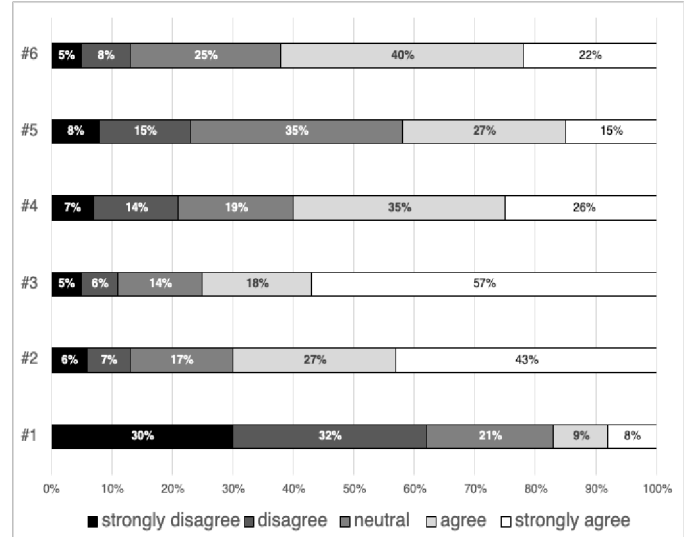


Fig. 1. Percentage of students at various agreeing level for each statement.

V. IMPLEMENTATION AND AUTOMATION PROCESS

One of the major impediments of adopting techniques that increase student engagement is the extra work that creates for the instructor. To this end, we have built a system such that it creates minimal work for the instructor to implement. In this Section, we describe how we implemented the system in a course that meets three times a week for 50 minutes each time. We used Google platform for our activities, but we believe it can be adopted in other platforms with ease.

A. Pre-lecture: Preparing and posting the quizzes

The first and most time-consuming step is to create a plethora of short single-question quizzes. We aimed at having one quiz after about 10-15 minutes of class time. That results in 4-5 quizzes per lecture in our 50-minute sessions. The quizzes take between one to three minutes to complete.

The quizzes can be posted as a link inside the lecture notes for students to access. There is no need to assign a due date or assign a set amount of time to finish them, etc. The posting is a simple copy/paste of the Google quiz link that makes the question available to the students without any frills or details.

B. During lecture: Activating the quizzes

The instructor chooses the right time for the quiz in the flow of the classroom without prior arrangement. This allows the instructor to use the quiz when they find it appropriate. There is no need to set a specific due date or choose a predetermined length of time that students need to finish the quiz.

Since the google quiz is available to the students throughout the lecture, they can practically complete it at any time. However, we only accept the responses that are submitted after the instructor makes a quiz active for a predetermined amount of time. In our implementation, we allowed students to submit their responses within five minutes of the moment the quiz is activated. ***The key innovative feature of our approach is that the professor does not need to record a certain time for the start or finish of the quiz.*** All they need to do is to submit a response to the quiz. Our automated method marks the instructor's response time as the starting point of the quiz and marks all the responses within the next five minutes as valid. This forces students to stay mentally present with the class and take the quiz when the instructor asks them to do.

C. Post lecture: Grading and assigning points

The quizzes already have an answer key, and they automatically receive a grade. Google platform automatically generates a spreadsheet we call Quiz Spreadsheet (Q-S) and records all the grades in it. The challenge is that each quiz has its own spreadsheet and multiple quizzes are offered during each lecture. Since the instructor might pick and choose various quizzes based on the class needs and because sometimes multiple modules (slide sets) are covered during one lecture, we do not know in advance which Q-Ss should be used to calculate the Lecture Participation Point, LPP for each student.

To solve this problem, we use an innovative approach that automatically iterates through all Q-Ss and collects the data and separates them based on their date. Then, we calculate the average of the quizzes for each date to get LPPs, which are recorded in a new spreadsheet called LPP-S. The sum of LPPs over all the lectures is Gross Participation Point (GPP) which represents the overall participation performance of a student. As students spend their points to buy extensions, a new value is calculated as Adjusted Participation Points that shows how many points students possess to trade. Table II summarizes the glossary of major entities related to our approach and Figure 2 shows the flowchart of the algorithm.

TABLE II. SEASIDE GLOSSARY

Quiz Spreadsheet (Q-S)	One spreadsheet per quiz. Multiple Q-Ss exist for a given lecture. It contains all the student grades for that specific quiz.
Lecture Participation Point (LPP)	The average of the quiz grades for a given lecture for a given student; a number between 0 and 1 that represents students participation performance on a given lecture. Absent students or students with all wrong answers get 0. Students with perfect quiz grades for the lecture get 1.
LPP Spreadsheet (LPP-S)	A spreadsheet that contains all the LPPs for each student (rows) and each lecture (columns)
Gross Participation Point (GPP)	The sum of all the LPPs for a given student throughout the semester.
Adjusted Participation Point (APP)	GPP minus the points spent on extensions.

The students have access to their individual quizzes, LPP, GPP and APP through a copy of the spreadsheets where the student names are replaced with a secret ID that is only known to the student themselves. These spreadsheets are all created automatically, and the only manual process is providing the secret ID to each student at the beginning of the semester.

VI. CONCLUSION AND FUTURE WORK

The work presented in this paper provides a simple proof of concept that second-order incentives can motivate students take part more effectively in real-time class activities. Furthermore, the second-order incentives do not trigger extra accommodations needed for students with disabilities, nor induces stress among students, looking at them as a form of assessment. We also showed how using a widely available platform, the system can be automated, reducing the burden of administrative work on the instructors. For the future work, we intend to investigate who are the major beneficiaries of this approach. For example, we wish to look at students' gender, college acceptance status (entered as a freshman vs. as a transfer student), or prior programming experience. We wish to see if any of these characteristics have correlation with the student population who benefits from the addition of incentives. We are also hoping to implement a controlled experiment in a semester with two parallel sections where one uses the real-time activities with direct reward system and another with second-order incentives. This will allow us to compare attendance levels which is a metric we have not been able to evaluate in our current work.

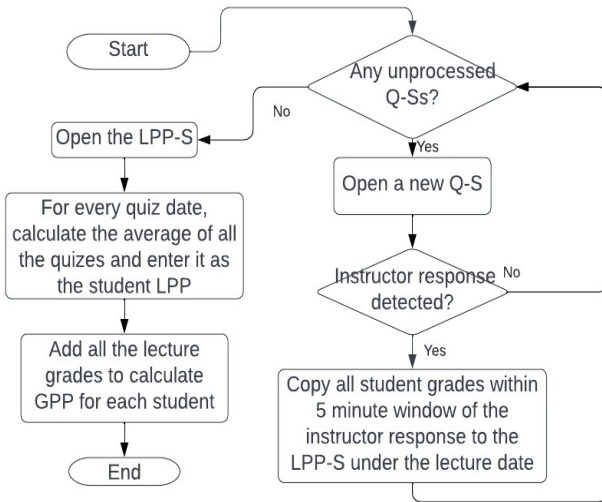


Fig 2. Post-lecture automation flowchart

ACKNOWLEDGMENT

The author wishes to acknowledge the help of her teaching assistants, Max Stelmack, Hao Xiang, and Zayeem Zaman, who contributed to the implementation of the SEASIDE method.

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