A mobile educational platform based on peer influence and instructional scaffolding for engaging students in out-of-class activities

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***Abstract*—It is a well-documented challenge to keep students engaged and motivated in out-of-class activities. More students now have part- or full-time jobs and less time to study. Supporting their academic growth and success requires acknowledging the higher commitments to the jobs while providing appropriate mechanisms to make the best use of their available times. This paper presents a mobile educational platform, Dysgu, that aims to engage students in out-of-class activities. An initial study completed on this platform investigates the role of peer influence to increase student engagement in an early college class. Data indicates students prefer Dysgu for out-of-class activities compared to traditional pen- and paper-based activities. Students noted that peer influence, in the form of scores compared to the rest of the class, was highly motivating. We also observed more on-time submissions when using Dysgu.**

***Keywords*-Mobile platform; student engagement; peer influence**

I. Introduction

The out-of-class activities are one of few time-proven approaches to build expertise in a subject matter. College classes strongly depend on out-of-class activities. The majority of such activities require students to spend a lot of time and effort outside the classroom. While in the past these activities proved sufficient to keep students engaged and motivated, now it has become a growing challenge to do so. Several contributing factors to this problem include an increased number of students with part- or full-time jobs, family commitments, and lack of an approach that makes out-of-class activities engaging to digital natives.

Researchers studied student engagement from different perspectives, including promoting student engagement [1] and measuring student engagement [2]. The majority of these efforts look into in-class activities. There is little work on reinventing out-of-class activities to achieve the same, or even higher, level of student engagement. This is where the proposed mobile educational platform, Dysgu, seeks to use a medium that current students are more familiar with. Dysgu provides an overview of the overall standing of the class in any out-of-class activity. Dysgu was designed following design principles that proved to be effective in similar contexts. The results from an initial study with Dysgu indicate students found it helpful to know where they stand among their peers in completing an out-of-class activity. Students also submitted out-of-class activities well ahead of time when using Dysgu.

II. Related Literature

Dysgu aims to make out-of-class activities engaging. Dysgu is designed to utilize peer influence to engage students in such activities and leverage mobile platform.

A. Peer influence for student engagement

The role of peer influence in non-academic and academic settings has been studied [3]. There are many forms of direct peer influence in education, including peer-learning, peer-teaching, and peer assessment [4]. Researchers have repeatedly found positive impacts of peer instructions on student performance and retention [5]. One study noted one of the non-academic factors influencing university students' self-regulation of study is peer influence [6]. Multiple researchers identified connections between peer influence and improved student engagement and academic performance [7].

B. Mobile educational platforms

Mobile platforms are frequently used to complement teaching and learning in formal and informal educational settings [8]. Mobile games are among the most used approaches that leverage the mobile platform for education [9]. Others use mobile apps to train or teach concepts [10].

III. Dysgu - A Mobile Educational Platform

Dysgu (http://dysgu.altl.org) [11], [12] is developed with features to achieve student learning goals and engagement outside the classroom. The current version of the software utilizes several self-management properties (e.g., automated session management, background data syncing, automated backup) to hide various complexities and make the system transparent from the underlying technology. The following sections will give a brief description to the software.

A. Overview of Dysgu

Dysgu is designed as a cloud-based client-server system. The cloud repository is used as an intermediary between the client and the server to communicate with each other in complete synchronicity and transparency. Figure 1 shows an overview of this framework. In the faculty computer, the faculty uses a user interface to create a class, add students to that class, create interactive activities, initiate problem-solving modules, create different reports, monitor student progress, and class status. However, to achieve all of these, the faculty does not have to run the software 24/7. On each student device, a client application (app) allows students to log in to the class, work on a problem-solving session, receive notifications, monitor their progress, or compare their progress with the class. Similar to the faculty-side software, the client-side app is also developed to run asynchronously. Any changes made by the faculty (and students on their mobile devices) are updated in the cloud repositories. In this way, the cloud repository is used in the background to provide transparent and seamless operations.

B. Dysgu Usage

The two stakeholders of Dysgu are the faculty and the students. Both have different user experiences and interact with the system differently. However, the goal of the design is to make the system easy to use. It is achieved by utilizing standard interface components and directed sequences of steps with visual cues (such as interface components are enabled or disabled depending on user interaction and therefore, will prohibit users from making erroneous choices

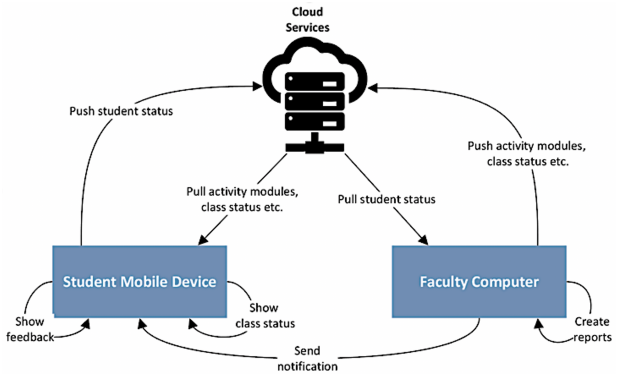


Figure 1: Dysgu data flow.

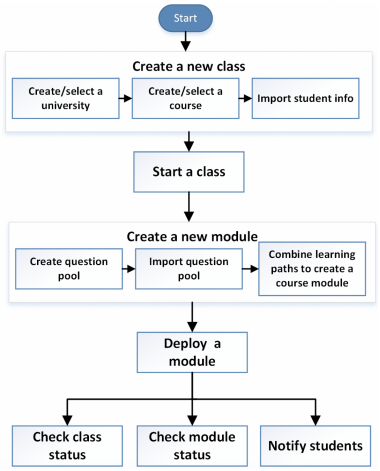


Figure 2: Dysgu – Workflow on the facultyside.

that might cause the system to fail). Consequently, faculty can follow a few easy steps to deploy a class and initiate a module with a list of out-of-class activities (Figure 2). Similarly, the students can easily join a class and set up their personalized schedules to work on the out-of-class activities (Figure 3).

C. Key Design Principles

Although the authors have visualized this system, design decisions for Dysgu were mostly directed by several mobile learning requirement catalogs [13], [14], [15] to make the software more responsive, engaging, and motivating. The major decisions for the design were to have the following dimensions to the software (highlighted in bold text).

The system's background operations are **transparent** to the stakeholder to eliminate the need for administration or day-to-day management. It is achieved through a cloud-based repository designed explicitly for Dysgu. We utilized a proprietary format of the repository to provide better **privacy, security, and access performance** of such data.

The system was designed and developed to **support wider adoptions**. Neither the faculty nor the students have to maintain or pay for the cloud infrastructure and services, as Dysgu only uses cloud vendors' free options. To provide features that contribute to student learning, Dysgu allows activities to be put in learning paths with different degrees of difficulties to support **instructional scaffolding**. As shown

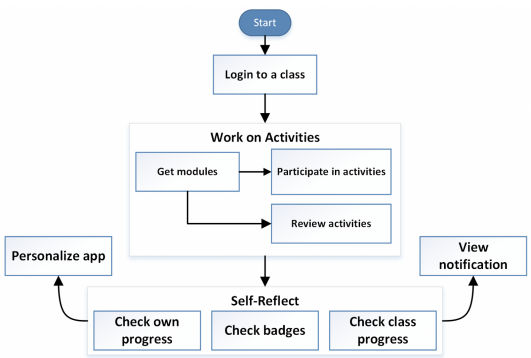


Figure 3: Dysgu – Workflow on the student side.

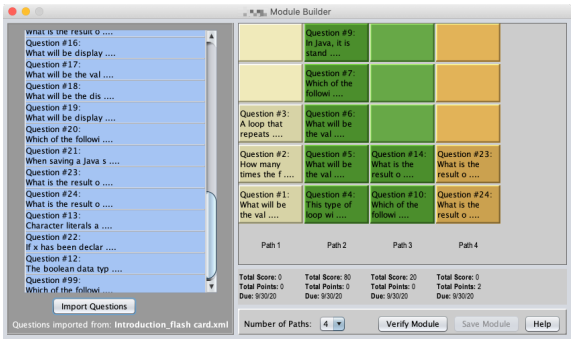
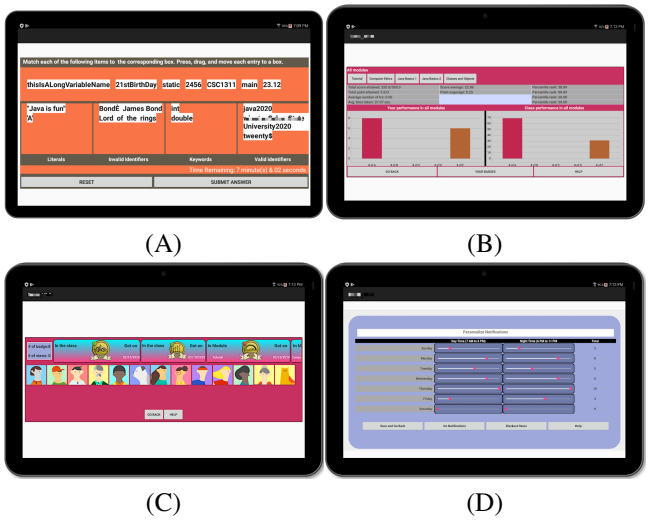


Figure 4: Learning paths in Dysgu.

in Figure 4, a module (i.e., an out-of-class activity) can have different learning paths with different activities. Some of the modules' path can be designated as a practice path to help students practice the concept. Other paths are designated as student learning outcome (SLO) paths, where students are assessed for their learning skills. Some paths can be assigned as extra credit, which has problems that require additional effort from students. Students can earn a score in the SLO path, which is used to calculate their course grades; however, students can only earn points by solving problems in other paths. Points are treated as internal currency that students can use to extend deadlines or for other purposes.

As we want students to actively participate in problem-solving, each activity in a path is modeled as an **interactive activity**. While these activities have to be finished within a time-frame, they should have interactive elements, such as multiple screens, multiple user interface components to interact, cause-effect scenarios, and ways to traverse the problem before submitting it for grading. Figure 5(A) shows a sample interactive activity where student classifies entries by dragging them to the corresponding bucket.

Dysgu provides **lightweight gamification** and social networking aspects within the scope of privacy and student regulations for motivating and engaging students. A student can compare their progress (Figure 5(B)) with their classmates. Dysgu shows the student's score, placement (module, path, problem-specific) compared to the class, and timing information about problem-solving activities.



(A) (B)

(C) (D)

Figure 5: Dysgu Screenshots (A) An interactive activity; (B) Score comparison with the rest of the class; (C) Gamification in Dysgu; (D) Notifications.

Additionally, students are awarded **badges** for different achievements (e.g., highest score). Students are able to compare their badges with the rest of the class (Figure 5(C)). Dysgu is developed to support different class situations and **personalization** to address varying student needs. For instance, the client app allows students to set the number of notifications per day or blackout dates (Figure 5(D)).

IV. Study Details

Although Dysgu can be used with any level of college students, we envision it to be used with freshman and sophomore students. Usually, sophomore students struggle more with the transition from high school to college and with time management. The intended intervention on out-of-class activities through Dysgu should have a better impact on their learning and engagement outside the classroom.

A. Overview of the Class

Dysgu was used at Winston-Salem State University in a freshman class titled *CSC 1311: Computer Programming II* in Spring 2020 in a face-to-face mode. Two out-of-class assignments were administered using Dysgu. Of the 11 students (5 Females and 6 Males), nine participated in the first assignment, and ten participated in the second one.

B. Overview of the Modules Used

The *CSC 1311* course is a continuation of the *Programming I* course. The out-of-class activities administered at the beginning of the *CSC 1311* course were used to assess students' knowledge of the course content. The proposed Dysgu platform was used twice in Spring 2020 to administer two separate out-of-class assignments. Each module (i.e., assignment) developed on Dysgu had the following properties:

- There was one practice path in each module.
- There was an extra credit path in some modules. Activities in the extra credit path gave points (not scores).
- Each activity can only be taken once (no re-takes).

C. Evaluation

The initial study collected usage data through Dysgu and qualitative data through surveys. Students completed a pre-survey before using Dysgu, an experience survey while using Dysgu modules, and a post-survey after using Dysgu. The pre- and post-survey had questions in the following five categories: personal information, view towards out-of-class activities, view towards technology and its use in out-of-class activities, perception of learning, and perception of motivation/engagement. Most of the questions used a 4-point Likert scale. The experience survey questions were specific to the features of Dysgu.

V. Results and Discussion

The study collected both quantitative and qualitative data of Dysgu, results of which are described next.

A. Quantitative Study

The initial study includes data collected from deploying two Dysgu modules in Spring 2020. The modules' questions were similar to two assignments of Fall 2019 in the same course, administered using Canvas – an online course management platform. A detailed analysis of these assignments' submission time, with and without Dysgu, is shown in Figure 6. As seen in this figure, when using Dysgu majority of students (¿90%) complete their assignments more than 24 hours before the deadline (Figure 6 *With Intervention*). Without Dysgu, when the regular online platform (i.e., Canvas) was used, only 18% to 42% of students completed their assignments 24 hours before the deadline (Figure 6*Without Intervention*). Without Dysgu, the percentages of students completing their assignments within the last 5 hours of the due date were 42% to 68%. The trend of early-submission with Dysgu is a strong indicator that students are more engaged with out-of-class activities when using Dysgu.

The grades earned by the students portray a different picture, as seen in Figure 7. There is a noticeable reduction in the number of students receiving D-F grades with Dysgu. Without Dysgu, the D-F student percentage ranges from 44% to 33%. With Dysgu, this number falls between 10% to 11%. We also observe a greater variety of grades in the assignments in Dysgu than the traditional platform (i.e., Canvas). More students received a grade of B or C when using Dysgu. Further investigation is needed to identify the possible cause of these variations. One hypothesis is that students may be tempted to respond quickly with a mobile platform, without taking time to review their answers. In summary, the quantitative data from the pilot study strongly indicates Dysgu has an overall positive effect on student's grades (less D-F), and students submit their assignments much earlier than they usually do (within the last 5 – 24 hours). Both of these factors indicate Dysgu can keep students engaged with out-of-class activities while motivating them in timely submission.

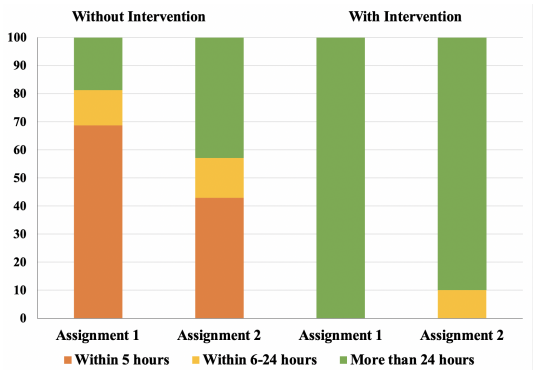


Figure 6: Effect of Dysgu on submission time.

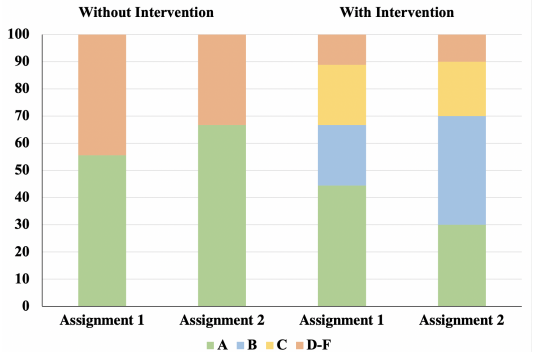


Figure 7: Effect of Dysgu on the grades.

B. Qualitative Study

The 26 pre- and post-survey questions can be grouped into four categories: view towards out-of-class activities (e.g., *out-of-class activities allow me to learn better than while I'm in the class*), view towards technology usage in out-of-class activities (e.g., *I prefer out-of-class activities that can be completed using mobile devices*), perception of learning (e.g., *using interactive out-of-class activities enhanced my learning*), and perception of motivation/engagement (e.g., *when I see how my peers did in the out-of-class activities, it increases my course engagement*). The experience survey included 12 questions on the effects of Dysgu in time management, motivation (e.g., badges, score comparison), and student learning.

In the **pre- and post-survey**, there were several questions where the responses changed noticeably after using Dysgu. Briefly described are some of the questions that observed a difference magnitudes equal to four or greater. One such question was *I do not like out-of-class activities as part of the course work*. More students selected *Strongly Disagree* in the post-survey. In another similar question, more students *agreed strongly* with the statement *out-of-class activities allowed me to learn better than while I am in the class*. After using Dysgu, more students *strongly agreed* that they wanted faculty to incorporate more out-of-class activities into courses. Finally, after the introduction of Dysgu, students indicated less enthusiasm about pen- and paper-based assignments for their out-of-class activities.

One of the two questions with the most significant differences asked if students *do NOT find the use of technologies for out-of-class activities to be helpful or motivating*. The responses changed significantly from *agree* and *strongly agree* to *disagree* and *strongly disagree*, indicating after using Dysgu more students found technology to be helpful for out-of-class activities. In the second question, while there were no students who *strongly agreed* with the statement that they *become anxious when using new technologies for coursework*, four students changed their responses from *agree* to *disagree*. Hence fewer students felt anxious about using a new technology after being exposed to the software. **Nine out of the ten students** who responded to the experience survey agreed that they find seeing their grades

in comparison to the rest of the class helpful. Students often believed they are doing well without knowing that many other students have performed significantly better on specific assignments. For the response to a question on the experience survey that asked if students *enjoy using Dysgu to complete out-of-class activities as per their own schedule*, eight students *strongly agreed* or *agreed*. This single question captures the essence of student responses from this survey. Finally, the **grade comparison feature** was the one that students **liked the most**. To summarize the results of the qualitative study:

- More students liked out-of-class activities after using Dysgu.
- Students *agreed strongly* with the statement that out-of-class activities allow them to learn better than while they are in the class.
- Students want faculty to incorporate more out-of-class activities into the courses they teach.
- Students also agreed that faster feedback on assignments helped them to learn better, and after using Dysgu, they no longer liked pen- and paper-based activities for their out-of-class activities.
- Students found seeing their grades in comparison to the rest of the class extremely helpful. Students also liked this feature the most.

VI. Conclusion

This paper presents the results of an initial study conducted using Dysgu, a mobile educational platform. Dysgu is designed to keep students engaged in out-of-class activities using a mobile platform that provides peer influence, gamification, and faster feedback than traditional homework or assignments. The results indicate students prefer a mobile app over a pen- and paper-based approach for out-of-class activities. Students also find it motivating to know the overall class status of such activities. Furthermore, the data strongly shows that students are more likely to submit out-of-class activities earlier when using Dysgu. The study also observed a noticeable drop in students receiving failing grades when using Dysgu. Due to the promising results, we will carry out extensive studies in the next phase. Dysgu will be launched in different universities in early Computer Science courses to collect data to validate current findings.

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