The Effectiveness of a Mobile Educational Platform for Engaging Students in Out-of-class Activities

Muztaba Fuad
Department of Computer Science
Winston-Salem State University
Winston-Salem, NC, USA
fuadmo@wssu.edu

Monika Akbar
Department of Computer Science
University of Texas at El Paso
El Paso, TX, USA
makbar@utep.edu

William D Croslen
Department of Computer Science
University of Texas at El Paso
El Paso, TX, USA
wdcroslen@miners.utep.edu

***Abstract*—Getting students engaged with out-of-class activities has been a long-standing challenge. With large class sizes, providing timely feedback to students is also challenging for faculty members. Students are spending fewer hours to study class content outside the classroom for several reasons, including working more hours because of rising tuition and living expenses. This paper describes a newly developed mobile learning system, Dysgu, which provides an engaging learning experience for students outside the classroom. Dysgu has interactive and auto-graded exercises to help students practice concepts. Students can see their progress and class standing as they work on the exercises. The mobile platform was deployed in two semesters at two different universities. We saw improved student grades, more on-time submissions, and the acknowledgment of useful features such as interactive activity and the ability to see the overall class status using this new mobile platform.**

***Index Terms*—Mobile learning platform, gamification, scaffolding, peer influence, interactive problem-solving.**

I. Introduction

Classroom instructions and activities form the core of formal learning. Since limited class time (at the college level) is not enough to help students build their skills, out-of-class activities, such as homework or assignments, are frequently used to complement the learning process. Such out-of-class activities also help students build skills in time management, independent learning, and self-efficacy. However, it has been a challenge to occupy students with out-of-class activities [1]. Students are spending more hours working part or full-time for several reasons [2]. The current student population, often known as digital natives or Generation Z, has different motivating factors, including gamification or peer influence.

This paper presents the results of a study conducted at universities with two different student populations that investigates the impact of a mobile-based educational platform, named Dysgu, on keeping students engaged in out-of-class activities. Although active learning is valued as an effective technique for improving student learning and engagement, it is often not utilized for out-of-class activities and traditional unsupervised activities are used mostly to keep students engaged in the content after the class. Dysgu enables active learning for out-of-class activities and through the transformational role of mobile devices, allows students to participate in out-of-class activities anywhere, at any time. Dysgu aims to increase student engagement with out-of-class activities and reduce procrastination. Dysgu allows faculty to monitor learning even after the students left the classroom and facilitate early intervention when students fall behind.

II. Related Work

Dysgu is designed to engage students using a mobile platform – which the current generation of students is more familiar with. Dysgu incorporates features to support peer influence and gamification to motivate students, hence achieving higher student engagement in out-of-class activities. Various methods have been proposed (e.g., flipped classroom) [3], and tools developed (e.g., Piazza, Kahoot) for student learning and engagement outside the classroom. In recent years, mobile oriented educations platforms are utilized to support classroom teaching and student learning in various scenarios [4], [5].

Various forms of peer influence, including peer teaching, peer learning, peer assessment, etc., have been studied for a while [6]–[9]. Peer influence was shown to improve student performance, self-regulation, engagement, and retention [10]–[14]. Gamification is a form of peer influence that improves student engagement [15]. Dysgu includes aspects of gamification to support peer influence by enabling students to compare their status in real-time with a summarized view of the rest of the class's position. Dysgu is more likely to reduce procrastination due to the interactive nature of activities that uses instructional scaffolding – a component that engages students sooner [16].

III. Features of Dysgu

Dysgu was developed to increase student learning and engagement in out-of-class activities. It provides various interactive elements, such as multiple screens, different user interfaces, cause-effect scenarios, and the ability to move through the exercise before submission. Dysgu also includes a lightweight gamification component and social networking aspects (within the scope of established privacy regulations). A student can compare their standing in the class with their classmates. Dysgu shows the student's score and their placement in each module or different paths (e.g., SLO) and on a specific problem. Alongside that, each student can compare their standings with other students in the class. Dysgu also

presents timing information, such as completion time, on each question and module. Students earn badges based on various activities (e.g., fastest in answering, getting highest score, first one to successfully answer, etc.) and can compare their badges with those earned by their peers in the class.

Dysgu includes features enabling students to set the number of notifications they will receive daily. Dysgu also has options for blackout dates. Such features allow students to synchronize their study time, class time, work, and other daily activities. Details of Dysgu are available in [17], [18].

IV. Experimental Evaluation

Our hypothesis is that students' usage of Dysgu will increase their engagement with out-of-class activities, which will improve their learning. The mobile-based and interactive Dysgu app with real-time status updates, and the peer influence nature, will allow the students to comprehend and retain the subject material better. We are also interested in exploring the impact of Dysgu on two different student demographics. We gathered and analyzed students' feedback about the strengths and weaknesses of using Dysgu. The data and the following research questions directed this research. Section IV-C addresses these questions in more detail.

1) Does using Dysgu help improve student learning performance?
2) What is the effect of scaffolded out-of-class activities on student procrastination and participation?
3) What features of Dysgu is more engaging and useful to students?
4) What are some common student behaviors for out-of-class activities, as observed in Dysgu?
5) Is there a difference between how Dysgu impacts the different student demographics?

A. The study setting and design

We deployed Dysgu in the CS1301 (CS1) course at the University of Texas at El Paso (UTEP) and in the CSC/CIT 1311 course at Winston-Salem State University (WSSU). These courses exposed freshmen students to Java programming language. Table I shows the software's deployment and data collection timeframe. *Without Intervention* are the semesters where Dysgu was not deployed, and *With Intervention* are the semesters when we used Dysgu in the class. At UTEP during the Spring 2022 semester, the second Author taught two sections of the CS1 course, where Dysgu was deployed in one section, while the students in the other section submitted their out-of-class homework using Blackboard.

TABLE I
Deployment details.

Univ.	Intervention	Semester	# of students
UTEP	Without intervention	Spring of 2021 Spring of 2022 (Sec. B)	66
	With Intervention	Fall of 2021 Spring of 2022 (Sec. A)	40
WSSU	Without intervention	Spring of 2019 Fall of 2019	31
	With Intervention	Spring of 2020 Spring of 2022	17

UTEP is a Hispanic-Serving Institution in El Paso, Texas. It is a majority minority school with an enrollment of 27,000 undergraduate students. Over 85% of these students are Hispanic-American [19]. WSSU, a predominately black university, is also a minority-serving institution with African American and other minority groups are the largest proportion of its student body [20]. Table II shows student information on both universities during the semesters when Dysgu was deployed. We can see that WSSU showed gender balance, whereas UTEP showed a familiar pattern of the majority male student population (i.e., 77%). Aside from that, the table shows that 70% of UTEP students were enrolled in 12 or more credit hours, and 93% of WSSU students had a similar course load. What is astonishing is that almost half the students at both campuses work more than ten hours per week.

In terms of assignments used in Dysgu, the same assignment was given before and while deploying Dysgu. Each assignment included a set of exercises. Before using Dysgu, the same exercises from a set of topics were given to the student using the Learning Management System (LMS) with a week's deadline. Students submitted their answers through the LMS. During the semesters when Dysgu was deployed, we used the same exercises (in Dysgu modules) to assess students' learning. However, to comply with Dysgu's scaffolded assignment approach, each module was structured as follows:

- Each module contained exercises from one single topic.
  - They contained the same questions as before from that topic.
- Each module had three paths:
  - The Student Learning Outcome (SLO) path shows one question at a time. Once the question is answered, the next question becomes available. Each question can be answered only once.
  - The practice path contains questions that help with practicing certain topics.
  - The extra credit path is optional and can be used to earn points (not scores).

Table III shows a comparison between the properties of these assignments.

Both authors taught the courses at their respective campuses in semesters shown in Table I. They maintained identical course settings and teaching practices before and during the study. Each participating student was given an identical Samsung tablet to diminish the impact of any confounding variables. Students took the devices with them outside the class (e.g., at home or work). At WSSU, Dysgu was used 2 times, whereas at UTEP, it was used 3 times. Table IV shows the content of each module deployed at each campus.

Out-of-class activities through Dysgu were used throughout the semester at UTEP in CS1. At WSSU, Dysgu was used in a freshman programming-I course at the first-half of the semester. This study in both campuses was approved by the Institutional Review Board (IRB) and performed following

TABLE II
STUDENT DEMOGRAPHICS INFORMATION.

Gender	UTEP	WSSU	Course load (credit hours)	UTEP	WSSU	Work hours	UTEP	WSSU
Male	77.27%	58.82%	Not full-time (<12 hours)	29.55%	5.88%	<10 hours	50.0%	52.94%
Female	18.18%	41.18%	Full-time (12 to 16 hours)	61.36%	70.59%	10 to 20 hours	18.18%	17.65%
Prefer not to say	4.55%	0%	Over full-time (>16 hours)	9.09%	23.53%	21 to 30 hours	15.91%	17.65%
						>30 hours	16.91%	11.76%

TABLE III
COMPARISON BETWEEN THE MODULES USED IN DYSGU AND LMS.

Similarities	Differences
→ **WSSU:** The modules were released on Monday morning and due on Friday at midnight. **UTEP:** The modules were due a week from the release date. → Each module (in Dysgu) and assignments (in LMS) had the same questions on the same topics.	→ **WSSU:** Students used a Word document to write their answers and submitted the document through the LMS. **UTEP:** Students answered the questions in the assignment through Blackboard questions. → In the LMS, students could answer the questions until the due dates. However, in Dysgu, students were given a set time to respond (around 5-10 minutes) once they started the module. The module was available until the due date.

TABLE IV
MODULES AND THEIR CONTENT.

University	Order in which modules were given	Content of each module
UTEP	First module	Variables
	Second module	Conditional statements
	Third module	Java Methods
WSSU	First Module	Ethics for programmers
		Java fundamentals
		Java class
	Second Module	Conditional statements
		Loops
		1D and 2D Arrays
		String processing

all protocols which are required for any research involving human subjects. Students participated voluntarily, and were not given any extra credits for participation or penalized for non-participation. Before the intervention was applied in class, all students were made aware of the study, its data collection, and data usage details, and students were asked to sign a consent form to participate.

B. Metrics

In order to assess students' learning improvement when Dysgu was used, we used the assignments and final grades as metrics for the evaluation of this study. The scores of the exercises deployed using Dysgu counted 12% at UTEP and 10% at WSSU towards the overall course grade. Students' long-term knowledge retention was assessed through a midterm and a final examination. These exams contributed 15% to 20% of the entire course grade. Failure or withdrawal rate for the assignments and overall course was also considered to assess students' knowledge acquisition and retention.

We also conducted *pre* and *post-surveys* in the class as part of this study. These surveys were administered to gather data on students' perceptions of traditional homework activities. Along with that, an anonymous *experience survey* was given to the participants once they used Dysgu. The goal of this survey was to assess student engagement and perception of Dysgu and its effectiveness. The students provided their input on the statements in the survey questions using a Likert scale of four values - Strongly Agree, Agree, Disagree, and Strongly Disagree. For quantitative analysis of the student response, the Likert scale was given a numeric value of 4 to 1, where 4 is for strongly agree, and 1 is for strongly disagree. In order to ensure that students are actually reading the survey questions and not just "clicking it through", all surveys contained positive and negative mode questions. The *experience survey* included the following open-ended questions.

1) Select the following features of Dysgu that you found to be most helpful.
2) What suggestions do you have to improve the Dysgu environment or your experience with Dysgu?

C. Results and discussions

Grade comparison: The first research question investigates Dysgu's impact on student performance. Fig. 1 shows the grade comparisons before and after using Dysgu in the class. The results show that fewer students fail when Dysgu is used, and on average student grades improve. The improvements in the highest grade (i.e., A) are more visible at UTEP; however, at WSSU, the decrease in the failure rate is more noticeable – a lesser failing rate is also an improvement in student performance. Dysgu is also useful for average or above-average students, who otherwise would receive a lower grade, but Dysgu allowed them to be more engaged. On average, the D/F/W (the percentage of students with either a grade of **D**, **F**ail, or who **W**ithdraw from the course) rate was reduced by 27%.

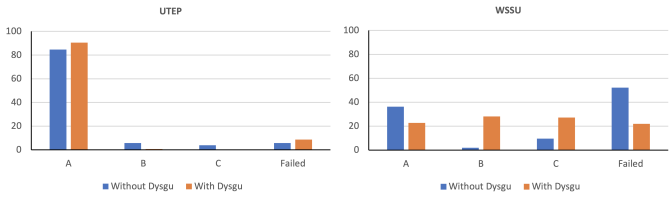

Fig. 1. Student's grade comparisons.

Timing information: The next research question investigates how scaffolded out-of-class activities affect students' procrastination and participation in out-of-class activities. An essential aspect of using Dysgu in class was to motivate students to start their work early to help them in reducing the chance of procrastinating and, as a result, submitting work that is not per standard or doesn't fully satisfy the activity's requirements. To understand that, Dysgu tracks students' activity submission time. It is presumed that if students start working on out-of-class activities closer to the deadline, they traditionally submit their work closer to the deadline. Data

from Dysgu shows (Fig. 2) that more than half of the students submitted at least 24 hours before the deadline compared to when they did their out-of-class activities without Dysgu. Such enhancements are visible on both campuses, where more students submitted earlier, and fewer submitted late in comparison to before Dysgu usage. Such early submissions indicate an earlier start on the activities and can be linked to their improved grade, as depicted earlier in the paper.

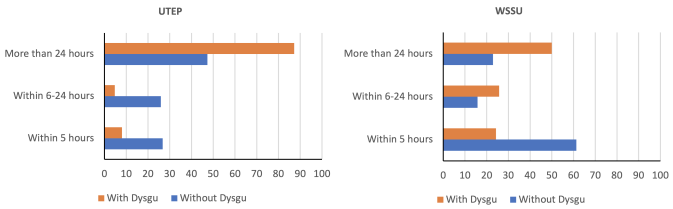

Fig. 2. Student submission timeframe.

Dysgu usage behavior: Dysgu is developed to collect student usage analytics and provide the faculty with anonymized and aggregated data on usage. We used such data to examine research question four. The time between 7 AM to 12 PM was classified as Morning, between 12 PM to 7 PM was treated as Afternoon, and between 7 PM to 11 PM as Evening. Although students showed anticipated usage patterns for different app features, their usage time showed something unusual.

Fig. 3 shows when students used the app to do out-of-class activities on both campuses. Although we anticipated that students would use the app more during the evening hours, we found that students used Dysgu more during the morning hours. It showcases the applicability of giving students out-of-class activities through mobile devices and how that facilitates students to study anytime compared to traditional approaches.

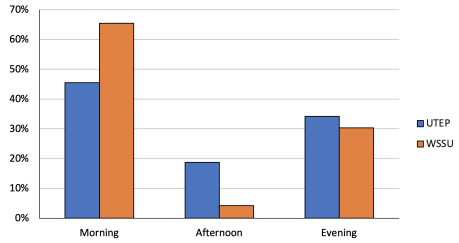

Fig. 3. Dysgu usage analytics.

Student experience: Research question 3 investigated the mobile platform's most attractive and useful features. A survey, which contained ten questions, was given (Section IV-B) to students on both campuses to gather students' impressions and experiences on Dysgu as they use that to learn through using out-of-class activities. As mentioned earlier, this survey also used the same Likert scale for all questions and also included two questions which were open-ended. In Fig. 4, the results of a subset of the survey questions are shown that reflects this paper's scope and focus. On both campuses, students found Dysgu to be helpful in managing their time (Fig. 4(a)), improving their problem-solving skills (Fig. 4(b)), and increasing confidence in completing out-of-class activities (Fig. 4(d)). In addition, they noted that Dysgu is intuitive to use (Fig. 4(c)) and does not require additional effort to learn the app (Fig. 4(e)).

These results represent a strong student approval of Dysgu-based out-of-class activities and positively attest to its functionality and effectiveness. As shown in Fig. 4, students reported favorable responses to the survey questions. For simplification and to better represent students' responses, two positive responses were combined as "Agreeing" and the two negative responses as "Disagreeing." Students on both campuses generally showed comparable feelings towards the intervention using Dysgu. Although WSSU students did not like the extra time spent learning to use the system, they contradicted by agreeing more than UTEP students on the app's intuitiveness. Table V shows the descriptive statistics (μ is used to represent mean, σ is used to represent standard deviation) for the student responses, which indicates students' uniform attitude towards this intervention, as reflected by a lower standard deviation value.

TABLE V
DESCRIPTIVE STATISTICS OF STUDENTS' EXPERIENCE SURVEY RESULTS.

	(a)		(b)		(c)		(d)		(e)	
	μ	σ	μ	σ	μ	σ	μ	σ	μ	σ
UTEP (N=24*)	2.9	0.7	3.0	0.8	3.0	0.9	3.4	0.7	2.3	0.9
WSSU (N=17)	2.9	0.8	3.1	0.8	3.1	0.5	2.9	0.9	2.4	1.1

*Not all participants took the survey.

On the *experience survey*, one of the open-ended questions asked students to pick Dysgu's most useful features. Fig. 5 shows student responses across both campuses. Students pointed out improved problem-solving skills and better exam preparation as useful features of Dysgu. Students also preferred interactive out-of-class activities. It is clear from the chart that students liked those features of Dysgu which enabled them to succeed in the course. It is also evident that students appreciate scaffolded out-of-class activities that provide interactive elements. Also, a mobile device's notification features are preferred as it reminds students of upcoming deadlines and allows them to manage their time better.

We observed several differences between the two student populations (research question five). UTEP students were three times more likely to use the app during the Afternoon and submit a day before when using the app. WSSU students had fewer D/F/Ws when using Dysgu. UTEP students showed more preference for pen-and-paper activities. WSSU students noted that such apps have a steep learning curve.

Pre and post-survey: These surveys were conducted to assess students' change of perception of the new intervention. Similar to the experience survey, we are using "Agreeing" and "Disagreeing" to summarise students' responses. All the responses for each statement were then aggregated to calculate the percentage. Finally, for each statement, the change in the percentage for the two choices was compared. Table VI lists those percentage changes.

For each survey statement, we calculated whether students' agreement or disagreement increased between pre and post-survey responses and listed the percentage of the increment. We anticipated specific response patterns for each statement if

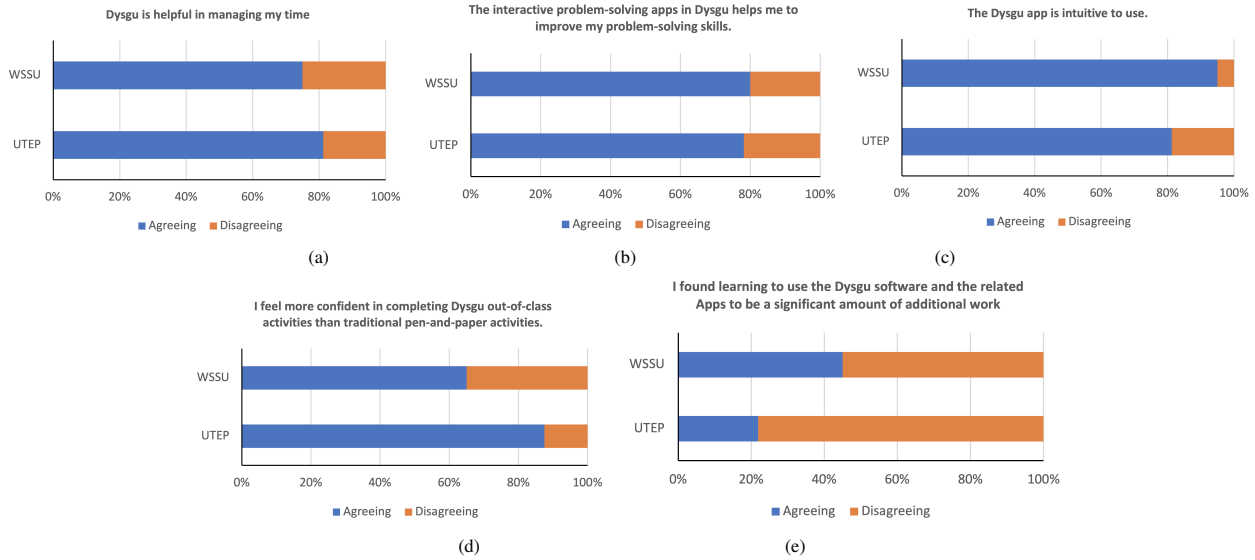

Fig. 4. Student's response to some questions in the experience survey.

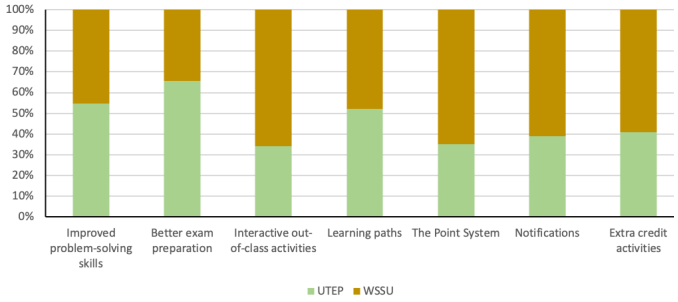

Fig. 5. Student response on useful features of Dysgu.

the intervention affected the students. For some statements, we expected an increase in the agreement; for others, we anticipated an increase in the disagreement. Although changes for most of the statements matched our anticipation, the changes in response for a few statements did not match our expectations and are highlighted in the table. For example, for statement B, although we anticipated that the scaffolded assignments with automated notifications and other features of the app should improve students' procrastination, their level of disagreement should increase. However, a bit of an anomaly can be seen at one of the campuses, although we noticed an improvement in their submission timeframe in Fig. 2. This could be due to several reasons, including the difference between the size of pre- and post-survey pools at UTEP (29 vs. 19 in Fall 2021 and 15 vs. 18 in Spring 2022) and possible confusion between Dysgu-based out-of-class activities and other forms of out-of-class activities (e.g., reading homework, programming assignments).

For statements F and L, the responses show a bit of anomaly. However, such an anomaly is inconclusive as the increment is very small ($< 1.5\%$) and needs further investigation. Finally, responses in statements K and N show that students at UTEP

TABLE VI
SUMMERY OF THE PRE AND POST SURVEY.

Statements	UTEP	WSSU
A. I do not like out-of-class activities as part of the course work.	Disagreement increases 3.68%	Disagreement increases 13.88%
B. I usually finish out-of-class activities at the last moment before the due date.	Agreement increases 3.47%	Disagreement increases 21.32%
C. I want faculty to incorporate more out-of-class activities into the courses they teach.	Agreement increases 12.44%	Agreement increases 40.07%
D. Out of class activities do not provide faster feedback.	Disagreement increases 9.81%	Disagreement increases 33.09%
E. I would like my professors to integrate more technology-based out-of-class activities into their courses.	Agreement increases 8.37%	Agreement increases 22.79%
F. I do NOT find the use of technologies for out-of-class activities to be helpful or motivating.	Disagreement increases 0.48%	Agreement increases 1.10%
G. I become anxious when using new technologies for coursework.	Disagreement increases 1.67%	Disagreement increases 40.07%
H. Learning to use technologies for coursework is simply additional work beyond the normal coursework.	Disagreement increases 8.97%	Disagreement increases 15.07%
I. I prefer out-of-class activities that can be completed using mobile devices.	Agreement increases 3.59%	Agreement increases 28.68%
J. Using interactive out-of-class activities enhanced my learning.	Agreement increases 1.20%	Agreement increases 11.03%
K. I learn very well with traditional pen-and-paper take-home writing assignments.	Agreement increases 9.45%	Disagreement increases 20.59%
L. I like classes that allow me to practice concepts taught in-class in a hands-on-approach such as take-home activities.	Agreement increases 1.20%	Disagreement increases 0.38%
M. When it comes to solving problems in out-of-class hands-on-approach, I prefer traditional pen- and paper-based activities.	Disagreement increases 3.23%	Disagreement increases 27.94%
N. In classes with only pen-and-paper take-home writing assignments, I consider myself very much focused and engaged while working on out-of-class activities.	Agreement increases 11.36%	Disagreement increases 8.82%

still preferred the traditional approach even when they liked other facets of the intervention. This is an unusual response in the class context, which is less pen-and-paper oriented and more programming-focused. We believe that the lack of specificity in statements K and N has made students generalize these statements for all university courses. Regardless of the few anomalies, the pre and post-survey data reconfirms the novelty of this platform, and shows how it can positively impact students' engagement in out-of-class activities.

Students' comments: Students were asked to give suggestions on improvements in the experience survey. Around 96% of students at UTEP and around 87% at WSSU provided comments on the approach and software. Following are a few comments that reflect some of the suggested improvements of the app and are extremely helpful for us in identifying the current limitations of the app and future enhancements.

> *"If there was a time limit for the whole quiz instead of each individual question".*
>
> *"better GUI interface".*
>
> *"Dysgu should include more challenging questions".*
>
> *"clearer examples for the questions, I found some of the questioning confusing and it was sometimes difficult to determine what the question was asking for".*
>
> *"Maybe it would be better to have more questions."*
>
> *"More reminders would be helpful".*

V. Conclusion

This paper shows the results of using a mobile educational platform to engage students in out-of-class activities. The Dysgu app leverages students' usage of mobile devices for interaction and learning outside the classroom by providing an interactive platform to support engaged student learning. This learner-centric, interactive approach instantly evaluates students' learning and informs them about their class standing. Results show that more students achieve better grades when using Dysgu. Additionally, less student procrastination was observed while using Dysgu, and there was a substantial improvement in students' submission timeframe. Data shows a significant improvement in student performance (e.g., lower D/F/W rate) and on-time submission (e.g., more submissions 24 hours before the deadline). Students also pointed out that they find several features of the platform – such as grade comparison (with the rest of the class), self-assessment, and real-time progress updates – useful in staying engaged with the out-of-class activities. Students also noted that they find the platform to be helpful for managing their time and improving their problem-solving skills. An extended version of this work, which concentrates more on the peer influence aspect of this research was published as a journal article [21].

Acknowledgments

This research is supported by National Science Foundation grants #1712030 and #1712073.

References

[1] G. D. Kuh, J. Kinzie, J. Buckley, B. K. Bridges, and J. C. Hayek, "What matters to student success: A review of the literature," 2006.

[2] S. A. Nonis and G. I. Hudson, "Academic performance of college students: Influence of time spent studying and working," *Journal of education for business*, vol. 81, no. 3, pp. 151–159, 2006.

[3] E. Safapour, S. Kermanshachi, and P. Taneja, "A review of nontraditional teaching methods: Flipped classroom, gamification, case study, self-learning, and social media," *Education Sciences*, vol. 9, no. 4, 2019. [Online]. Available: https://www.mdpi.com/2227-7102/9/4/273

[4] N. P. Huy and D. vanThanh, "Evaluation of mobile app paradigms," in *MoMM*, 2012, pp. 25—30.

[5] R. F. Kizilcec and M. Chen, "Student engagement in mobile learning via text message," in *Learning @ Scale*, 2020, pp. 157—166.

[6] S. Ciranka and W. van den Bos, "Social influence in adolescent decision-making: A formal framework," *Frontiers in Psychology*, vol. 10, p. 1915, 2019.

[7] B. H. Golsteyn, A. Non, and U. Zölitz, "The impact of peer personality on academic achievement," *Journal of Political Economy*, vol. 129, no. 4, pp. 1052–1099, 2021.

[8] M. Biggers, T. Yilmaz, and M. Sweat, "Using collaborative, modified peer led team learning to improve student success and retention in intro cs," in *Proceedings of the 40th ACM Technical Symposium on Computer Science Education*, ser. SIGCSE '09, 2009, pp. 9—13.

[9] H. Sondergaard, "Learning from and with peers: The different roles of student peer reviewing," *SIGCSE Bull.*, vol. 41, no. 3, pp. 31–35, 2009.

[10] D. Zingaro and L. Porter, "Peer instruction: A link to the exam," in *Proceedings of the 2014 Conference on Innovation amp; Technology in Computer Science Education*, ser. ITiCSE '14, 2014, pp. 255—-260.

[11] I. O. Pappas, M. N. Giannakos, and L. Jaccheri, "Investigating factors influencing students' intention to dropout computer science studies," in *Proceedings of the 2016 ACM Conference on Innovation and Technology in Computer Science Education*, ser. ITiCSE '16, 2016, pp. 198–203.

[12] R. Balapumi, B. R. von Konsky, A. Aitken, and D. A. McMeekin, "Factors influencing university students' self-regulation of learning: An exploratory study," in *Proceedings of the Australasian Computer Science Week Multiconference*, ser. ACSW '16, 2016.

[13] D. DeLay, L. Zhang, L. Hanish, C. Miller, R. Fabes, C. Martin, K. Kochel, and K. Updegraff, "Peer influence on academic performance: A social network analysis of social-emotional intervention effects," *Prevention Science*, pp. 1–11, Jul. 2016.

[14] C. J. Furrer, E. A. Skinner, and J. R. Pitzer, "The influence of teacher and peer relationships on students' classroom engagement and everyday motivational resilience," *National Society for the Study of Education*, vol. 113, no. 1, pp. 101–123, 2014.

[15] T. D. Indriasari, A. Luxton-Reilly, and P. Denny, "Gamification of student peer review in education: A systematic literature review," *Education and Information Technologies*, pp. 1–30, 2020.

[16] S. A. Ambrose, M. W. Bridges, M. DiPietro, M. C. Lovett, and M. K. Norman, *How learning works: Seven research-based principles for smart teaching*. John Wiley & Sons, 2010.

[17] M. Fuad, "Dysgu: A tool to keep students engaged outside the classroom," in *2019 IEEE International Conference on Engineering, Technology and Education (TALE)*, 2019, pp. 1–8.

[18] M. Fuad, M. Akbar, C. Gloster, N. Aun, and L. Zubov, "A mobile educational platform based on peer influence and instructional scaffolding for engaging students in out-of-class activities," in *2021 Intl. Conf. on Advanced Learning Technologies (ICALT)*, 2021, pp. 61–65.

[19] UTEP, "UTEP at a Glance," https://www.utep.edu/initiatives/at-a-glance/, 2022, [Online; accessed 17-Sep-2022].

[20] UNC, "UNC Data Dashboard," https://myinsight.northcarolina.edu/t/Public/views/db_enroll/BuildYourOwnReport?%3Aembed=y&%3AisGuestRedirectFromVizportal=y&iid=1, 2022, [Online; accessed 17-Sep-2022].

[21] M. Fuad and M. Akbar, "Effect of peer influence and self-reflection on scaffolded out-of-class activity administered using a mobile application," *Education Sciences*, vol. 12, no. 12, 2022.