

HIGH SCHOOL MATHEMATICS STUDENTS' ENGAGEMENT USING PEAR DECK**¹Julie B. Fiamingo and ^{2,*}Deana J. Ford**¹Clarke County School District, Athens GA, 30606 USA²Tift College of Education, Mercer University, Atlanta GA, 30341 USAReceived 20th September 2022; Accepted 14th October 2022; Published online 23rd November 2022

Abstract

The purpose of this study was to compare Pear Deck enhanced lessons to regular lessons on student engagement in high school mathematics classes. The results revealed no significant differences in students' engagement between the Pear Deck lessons and the regular lessons. However, students did report higher engagement scores with the Pear Deck lessons over the regular lessons for all subcategories of the lesson framework: opener, transition, work session, summary, and assessment. Teachers can incorporate Pear Deck lessons easily into their pre-existing lessons and increase their students' engagement levels.

Keywords: Pear Deck, Engagement, High School, Mathematics.

INTRODUCTION

I recently had a student take an entire test while watching *Squid Games* on the student's personal phone. The student actually did well on the test but their choice of an acceptable test-taking environment brought up a new issue for me as their mathematics teacher. How do I compete for students' attention and foster engagement in the classroom? Connectivity along with instant access to entertainment 24 hours a day are the new normal for most students in our nation's high schools. Older methods, such as lecturing at the chalk board or giving 50 practice problems for students to sit and complete, can no longer be acceptable methods for successful learning environments. Teachers must continue to evolve and integrate better tools with teaching strategies to encourage students to engage with the work in order to keep up with changing technology. After nineteen years of teaching and seeing students struggle with communicating students' own learning needs as well as students' successes, I know how important it is to have quality moments of engagement to allow students time to grow and learn during the course of a lesson. But how do educators know which emerging tools will benefit our students? The Covid-19 pandemic and resulting virtual teaching led me to branch out and find new ways to interact with students through a google slides add-on called Pear Deck. Pear Deck is a versatile tool I used to help bridge the gap between students' effort and participation in the virtual setting as well as face to face classes. Pear deck allows teachers to see student engagement in real-time and to offer feedback directly to the student or class as a whole through various formats which, according to Litz (2021), is an important part of student engagement. I have found little research about the effect Pear Deck has on student engagement levels, though literature on classroom engagement and motivation can be found for high school mathematics students. Other uses of technology such as I-Pads and student response systems, along with software like IXL and i-Ready, has been shown to increase student engagement (Chipangura and Alridge, 2016).

In addition to these, using social media such as Facebook, Twitter, and YouTube have been shown to increase student engagement as well (Abo-Alhija, 2021). Offering students chances for sharing their thoughts with others and with the teacher through rich experiences are connected to perceived engagement levels (Wang *et al.*, 2020; Forrester *et al.*, 2017). If student interaction is at the forefront throughout mathematics lessons then students have the opportunity to engage more frequently than a more traditional lecture or teacher focused lesson and teachers can compete with the never-ending stream of entertainment by keeping students engaged. Engagement in mathematics is a struggle for both teachers and students across all grade levels. Student engagement is in decline in mathematics in secondary years so teachers need to find methods to reach students in order to keep learning on level, or higher (Wang *et al.*, 2021). Pear Deck is a newer google slides add-on that has been looked at minimally in research but is a necessary tool that should be considered in order to help reach more students in mathematics. Haryani and Ayuningtyas (2021) explored college students in Linear Algebra who were taking classes online, both synchronously and asynchronously, and found that students and teachers both agreed that Pear Deck was a helpful tool that increased classroom engagement (Haryani and Ayuningtyas, 2021). Additionally, the researchers showed that Pear Deck lessons allowed students to interact, respond, and received real time feedback, which students viewed as more engaging. One reason Pear Deck led to an increase in student engagement was that students were given the opportunity to respond more deeply to more in-depth questions with their professors via the platform versus traditional methods such as volunteering an answer or being called on to show their work (Haryani and Ayuningtyas, 2021). Though little research exists for Pear Deck specifically, classroom engagement has been the focus of many research topics as engagement in the classroom is essential to student growth in mathematics. Research has shown that in order to be engaged, students should be interested in what tasks or learning students are doing in class (Abo-Alhija, 2021; Scheutz *et al.*, 2018; Wang *et al.*, 2021). In recent research by Wang and colleagues (2021), interest was shown to be the highest predictor of student motivation and

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engagement among middle grade students. Various observational and student self-reporting surveys have been used to show that students do better in class when students feel a sense of control over what students are working on and have ownership of their learning (Alrajeh, 2020; Forrester *et al.*, 2017; Kim *et al.*, 2015). According to Alrajeh (2020), teachers can set the stage for (or against) student engagement just through the teacher's interactions with students. Soliciting student responses, giving students a voice in the classroom, and allowing students to be active in their learning describe classrooms using Pear Deck. Another way student engagement is affected in mathematics classrooms is through being able to give and receive timely feedback. Feedback can include teacher remarks directly or other solutions to similar problems. Students that are involved in their own work while being able to see other solutions are more on task and engaged (Forrester *et al.*, 2017). Additionally, research has shown that immediate feedback is an important tool for student growth (Schuetz *et al.*, 2018). Through the simple method of using whiteboards, Forrester and colleagues (2017) found that student engagement was positively impacted when students could see each other's work and have their own work readily visible. Teachers can make students the focus of their classrooms by engaging students (with or without technology) if the tasks students are doing are rich and meaningful (Chipangura and Aldridge, 2017). Students need to see value in class work whether students are on-line or in person in order to stay motivated and engage with the course material (Kim *et al.*, 2015). Timely feedback and sharing student work are other characteristics of a classroom that uses Pear Deck. If teachers use Pear Deck appropriately during mathematics instruction, students will be more engaged during the lesson and mathematics teachers will have one less barrier in the way of student achievement (and one less episode of *Squid Games* will have been viewed). Therefore, the current action research studied the effects Pear Deck had on high school students' mathematics engagement in 10th and 11th grade math classes. Improving students' mathematics engagement will enhance students' learning and achievement. The study also aimed to fill a void in the current literature about high school students specifically and the use of Pear Deck in a live classroom setting. If student engagement can be improved with such a simple, yet powerful tool, then teachers can use Pear Deck to increase motivation and student achievement in their classrooms. By promoting student choice, motivation, rich tasks, timely feedback, and shared responses, Pear Deck could bring positive change to classrooms.

MATERIALS AND METHODS

The purpose of this study was to measure the effect Pear Deck enhanced lessons had on student engagement in high school mathematics classes. The significance of this action research study was to determine how student engagement was influenced by Pear Deck slides. A quantitative approach and a non-random two group posttest only design was used to investigate the following research question: How does the use of the Pear Deck add-on in google slides affect students' engagement in 11th and 12th grade mathematics classes. I hypothesized Pear Deck lessons would lead to an increase in student engagement and effort in mathematics classrooms.

Participants

Participants in the study attended a special high school program where students were dually enrolled, attending classes

for a local technical college and the student's own local high school as well. Some participants attended the program all day and others attended half the day. All other students in the program were excluded from the study as well as students who attended only the local high schools. I was the teacher of record for each of the participants and participants were all given the opportunity to choose to be a part of the study, with no repercussions for not participating. The 16 students who chose to be participants of the study were 11th and 12th grade mathematics students in Pre-Calculus and Advanced Algebra. These students were Black, Hispanic, and White, both male and female. Students in 9th and 10th grade and enrolled in other mathematics courses excluded from the study. All students and guardians provided assent and informed consent, respectively, to participate in the study. Any identifying information was removed from all data collection materials and anonymity was for reporting of results.

Measures

The independent variable for this research study was the method of presentation of the lesson being taught as either a Pear Deck lesson or a regular lesson. For the purpose of the study, a Pear Deck lesson was defined as a google slides lesson where 20% or more of the total slides included pear deck enhanced items. A regular lesson was defined as a google slide lesson with no pear deck add-ons. The dependent variable was the students' self-reported ratings of engagement, on a scale of 1-5, based on a survey after eight consecutive lessons of each type of lesson.

Data Collection Procedures

During the study I taught four regular lessons and four Pear Deck lessons over a period of four weeks to two classes of mathematics students. After each lesson students completed the student engagement survey (SES) at the end of each lesson. The first-time students received the survey, I went over the levels of engagement with each class and made sure participants had time to ask any questions about what the different numbers meant and to expect to complete one identical survey for the next seven lessons as well. All of the surveys were collected anonymously at the end of each class in a folder by the door of the classroom. Data was collected and input into SPSS for analysis.

Instruments

Student Engagement Survey: The Student Engagement Survey (SES) was a Likert-type survey that required students to self-assess their engagement during five phases of the mathematics lesson: opener, transition, work session, summary, and assessment (see Figure 1). The survey was based on a Likert-scale ranging from 1-5. The following descriptors were provided and discussed with the students in regards to the scales on the survey:

1. None: I checked the clock a lot, I did not pay attention, I stayed on my phone the whole time, I lost track of what we were doing.
2. Low: I drifted in and out but paid attention a little bit, I did a few of the things I was supposed to.
3. Moderate: I felt like I was engaged but not for very long, I know what we did but couldn't explain it.

4. Mild: I felt like I was engaged most of the time, I did check my phone and the clock a few times but participated, I know what we did and could explain some of it.
5. High: I felt engaged the whole time and never looked at the clock, I participated and could explain what we did to someone else, time went by quickly.

	None	Low	Moderate	Mild	High
Opener	1	2	3	4	5
Transition	1	2	3	4	5
Work Session	1	2	3	4	5
Summary	1	2	3	4	5
Assessment	1	2	3	4	5

Fig. 1. Example of student engagement survey

Materials

Pear Deck Lesson: Using google slides, I created four lessons for students with various prompts built in from the google add-on Pear Deck. The Pear Deck lesson slides included a minimum of 20% of the slides to be enhanced slides which required students to respond in some way. Pear Deck responses included drag and drop, short answer, written or drawing response slides, numerical answer slides, and general free response questions. For example, a drag and drop Pear Deck slide prompt would ask students to drag a dot to the correct position as an informal assessment tool during class. If the presentation slide is set to show student responses, then the red dots move in real time as students drag their dot to match whatever students are being prompted to identify (see Figure 1). Students were using district devices during the lessons and logged into the Pear Deck presentation throughout the duration of the lesson. As students responded to various prompts, I shared the responses with the class including correct and incorrect answers. I also used my own computer to check over student work on specific questions and offered feedback directly on individuals’ slides as students worked.

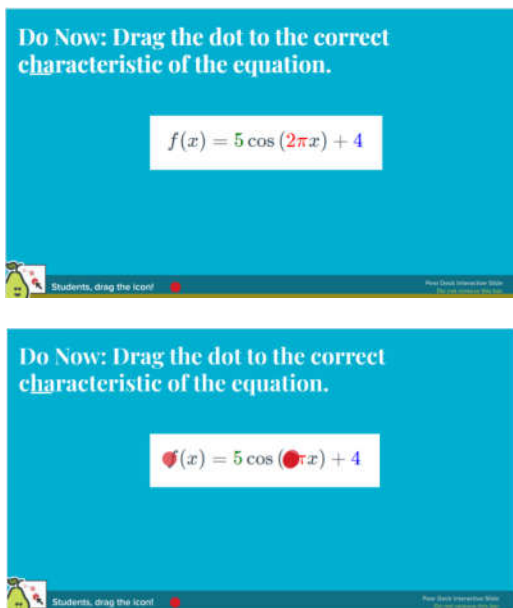


Fig. 2 Example of a Pear Deck drag and drop slide from a Pre-Calculus lesson on trigonometric equations before and after students’ interaction

Regular Lesson: Using google slides, I created four regular lessons that did not include the google add-on Pear Deck. I still used the slides for presentation of material for students such as warm ups, vocabulary, notes, and practice but I did not include the enhanced items on the slide-show of the lesson. For example, students were asked to identify the period and asymptotes of the equations, however, they wrote the practice questions and answers in their notebook rather than engaging directly with the slide (see Figure 2). For the regular lessons, I used more open-ended whole group questioning techniques and gave the students time to work out examples as I walked around and checked on individual work. I also asked for volunteers to share their work with the class and used small group and paired work during the lesson for informal formative assessment.

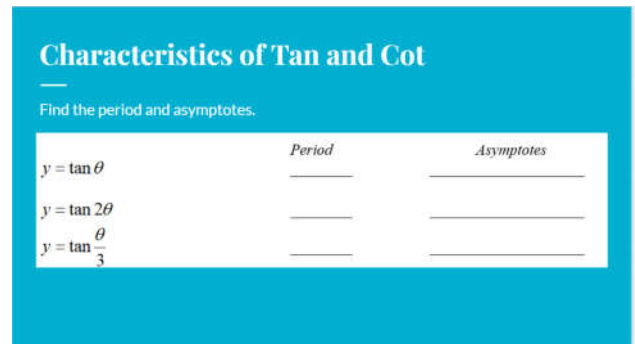


Fig. 3. Example of a regular lesson slide from a Pre-Calculus lesson on trigonometric equations with student response blanks

Data Analysis

There was one independent variable, group, that had two categories; the Pear Deck group and the regular instruction group. The dependent variable, student engagement scores, were calculated from the SES using a sum score ranging from 5-25. The data was entered into SPSS (Version 28.0) for data analysis. The data was analyzed using a Mann Whitney U test because we were comparing two groups on one dependent variable and the sample size was small.

RESULTS

The purpose of this study was to compare Pear Deck enhanced slides to regular class instruction slides. After working through four Pear Deck lessons and four regular lessons, students self-reported their levels of engagement on a scale from 1-5, with 1 being little to no engagement and 5 being extremely engaged. Data from all eight lessons was collected from 16 students over a period of three weeks. Descriptive statistics showed that students scored the Pear Deck lessons slightly higher than the regular lessons for the total score on the SES and each of the five subcategories (see Table 1).

Table 1. Students’ Scores on the Student Engagement Survey

	Pear Deck Lesson		Regular Lesson	
	M	SD	M	SD
Total	20.94	3.68	19.61	3.99
Opener	3.91	0.98	3.88	0.96
Transition	4.03	0.95	3.94	0.93
Work Session	4.33	0.78	3.94	1.00
Summary	4.25	0.84	3.93	0.87
Assessment	4.38	0.79	4.14	0.89

A Mann Whitney U test was conducted to determine if there were significant differences between the Pear Deck lesson and regular lesson on students' engagement total score. The results revealed no significant differences between the two groups, $U = 344.00$, $p = .121$. The results suggest that both the Pear Deck lesson and the regular lesson were effective for student engagement. Mann Whitney U tests were also used to examine the groups by each subcategory of the lesson framework: opener, transition, work session, summary, and assessment. No significant differences were found between the two groups and the subcategories of the lesson framework, $p > .05$, suggesting that the Pear Deck lesson and regular lesson were both effective for student engagement. Further exploration of the data showed more students reported 5's on their level of engagement on Pear Deck lessons than regular lessons. Students reported the highest level of engagement on the assessment portion of the framework in both types of lessons. Furthermore, the biggest difference in students' levels of engagement was identified during the work session where students were doing the bulk of their practice and learning. Overall the students' average engagement scores were higher for the Pear Deck lessons than the regular lessons. Interestingly, after the four Pear Deck lessons, students were asked to explain why they thought they were or were not engaged with Pear Deck. One student said "Pear Deck made me have to do my work because you could see it on the board when I did it." Another student said they did not like Pear Deck because they were "sick of using the computer" and would rather do their work on paper. Another student who preferred the regular lessons said that they did not like writing on the computer and that their handwriting was too big so it made their work messier. Yet another student stated that they like to have their notes on their own paper instead of a computer screen. Using Pear Deck lessons also allowed students to take ownership and responsibility for their work during the class and knowing that it could be shared in front of the class, even anonymously, led more students to complete their work on their lesson slides. One student said they liked Pear Deck because "I can see what everyone is doing and I don't have to stand at the board to be embarrassed." Another student who had used Pear Deck during the previous school year said they liked when you could see everyone's work on the same screen all together.

DISCUSSION

Students reported higher engagement on all phases of the instructional framework when the teacher used the Pear Deck enhanced lesson slides. The work sessions, summary, and assessment phases all showed that students were much more engaged using Pear Deck than the regular lesson. This is especially important in mathematics classes because those three phases are where student learning is most important and if students are more engaged during this time, students will learn more. It is also important for teachers to be able to quickly assess what students know during this time and pivot or adjust their lesson to accommodate the result of those assessments. Pear Deck lessons allowed that to happen. Formative assessment is an essential component for student learning (Butler and McMunn, 2014) and the built-in slides and the templates available on Pear Deck make adding opportunities for formative assessment into any lesson simple. Students rated their own levels of engagement higher during the Pear Deck lessons. Students were able to share their thinking and engage with the questions on the slides in real

time in the Pear Deck lesson through quick formative assessments that led to more participation than the typical lecture or raising hands to respond during a lesson. All students were able to respond to questions at the same time for the teacher to get instant, direct feedback. It is possible that students were also more engaged because they knew other students could see their work, even though it was anonymous, so students felt more like they had to share their thinking and engage in the lesson. This is a natural way to get students more involved in their classes and confirms that students learn more from collaboration (Abo-Alhija, 2021). Pear Deck also offered more chances for students to receive individual feedback which is an important instructional support that leads to student success (Alrajeh and Shindel, 2020). Pear Deck easily allows for teachers to see an entire class of thoughts at one time and offer immediate feedback with minimal effort or time taken away from class. It should not go unnoticed that the regular lesson was also effective for student engagement. The regular lesson included slides but without the Pear Deck add on. During the regular lessons I used open-ended and whole group questioning techniques, time management strategies, small and paired groupings, informal assessments, and other effective instructional strategies to maintain student engagement. Therefore, I propose, effective instruction, with or without Pear Deck, leads to student engagement (Alrajeh and Shindel, 2020).

Implications for Practice

Overall, findings from this study have several implications for practice. Engagement is essential to student learning, specifically in mathematics, and tools like white boarding and multimedia methods increase student engagement (Alrajeh *et al.*, 2020; Chipangura *et al.*, 2017; Forrester *et al.*, 2017). Pear Deck is another way to build in opportunities for students to engage more frequently during a lesson and it should be included as an option for formative assessment strategies. Other research showed Pear Deck improved on-line student's levels of engagement in college classes as well (Haryani *et al.*, 2021). Pear Deck can build student efficacy across grade levels, subjects, and mode of instruction. Pear Deck is an essential tool for on-line courses, whether courses are synchronous or asynchronous, because the platform allows students and teachers to interact in various ways. There are several different types of responses that teachers can include on Pear Deck slides in order to solicit different responses from students. For example, the drag an icon slide allows users to move a chosen icon to a specific place on their screen. The teacher can share this while the students so the class can watch what everyone is choosing, or keep it hidden until everyone has finished moving their icons, then show where students ended up. The pre-built templates in Pear Deck allow teachers to quickly create multiple choice, short answer, drawing, drag and drop, or even compare and contrast slides for any material in a matter of seconds. With such a simple switch from google slides to Pear Deck enhanced slides, teachers can increase their students' levels of engagement through offering them Pear Deck enhanced options for their class. Teachers should be trained to use Pear Deck efficiently as formative assessment in their classrooms.

Recommendations for Further Research

As very little research exists on the implications of using Pear Deck in educational settings, additional research is needed to

determine how Pear Deck influence students' learning in other ways. Also, this study was specifically focused on mathematics students in high school, but should be considered in studies of student engagement using a variety of methods such as social media, other answer sharing platforms, and white-boarding (Abo-Alhija, 2021; Chipangura *et al.*, 2017). Additional research could show which of these methods offers the most positive results for student engagement or even how that translates to student success and other factors that lead to student learning. Teachers' experience level, gender, and classroom management all affect student engagement levels and Pear Deck should be examined alongside these (Alrajeh *et al.*, 2020). In addition to the student perspective, the point of view of the teacher should also be considered in the future and examined to see how teachers feel about Pear Deck as a formative assessment tool.

Conclusion

The purpose of this study was to compare Pear Deck enhanced lessons and regular lessons on students' engagement. Students reported higher levels of engagement with the Pear Deck lessons on all five phases of their lesson framework – opener, transition, work session, summary, and assessment. Specifically, the biggest difference in levels of engagement was seen during the work session where students were doing the bulk of their practice and learning. These results suggest that teachers can improve student engagement levels by incorporating Pear Deck into their teaching repertoire. This has significant implications for future studies to see what other ways Pear Deck can help students and teachers in the classroom.

Competing Interests: The authors have no competing interests.

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