


LEARNING IS A KAHOOT! A LOOK AT ENGAGEMENT AND ITS EFFECT ON ASSESSMENT DURING THE COVID-19 PANDEMIC


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THESIS

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ABSTRACT

In response to the global pandemic, COVID-19, remote learning has become increasingly necessary. To assist in memory retention in education, teachers can use video games as a tool for interactive learning. This paper details a preliminary study examining the use of competitive video games as an interactive learning tool, designed to measure students' level of engagement. Through the use of Kahoot!, we compare short-term learning outcomes for groups of college and university students. We compare students' outcomes based upon their level of interaction with the game-based learning tool. In this study we developed assessments to coincide with the Kahoot! and followed each assessment with student surveys. Key findings show that Kahoot! enhanced the level of interaction and showed promising results for improving assessment scores.

DEDICATION

Dedicated to all teachers during this pandemic.

ACKNOWLEDGEMENTS

My wife, Kayla, without whom, this would not be possible.

Dr. Spradling, for never giving up on me.

My family and friends, for supporting me along the way.

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INTRODUCTION

The COVID-19 pandemic that triggered lockdowns in early 2020 created new challenges for educators. Class lectures that were primarily face to face, sharply transitioned to online remote learning, that left many teachers with little time to prepare. In a completely online format, this compounds on both the educator and the student, who have lost the ability to communicate non-verbally in the classroom. To mitigate the loss of having students in a physical classroom, educators needed to find new ways of connecting with students and keeping their attention in a virtual classroom.

One way to manage this is through an online game called Kahoot!. Kahoot! is an interactive game that can be used as a learning tool for reviewing any concept that the educator wants their students to know. This study is meant to test the effects of student engagement on assessment through the use of game-based learning. Here, we are defining engagement in accordance with the Australasian Survey of Student Engagement (AUSSE). AUSSE has six engagement scales: academic challenge, active learning, interactions, enriching educational experiences, supportive learning environment, and work-integrated learning. (Coates, 2010) Our study tests these six engagement scales through comparing active participation in game-based learning against passive participation though watching the game. We seek to demonstrate that engagement as defined by AUSSE is necessary towards increasing student engagement and that student engagement is a necessary component in higher assessment scores. In this paper, we discuss the methodology for the study using Kahoot! and the challenges of performing said study in a global pandemic. We will then quantify engagement and determine how reward-based learning, goal orientation, socio-cultural motivation, and psychological motivation paint a picture

of each individual student. Finally, we try to assuage fears about gamification in the classroom and then conclude by identifying areas of further research.

RELATED WORK

There are several examples of games being used to teach work-related concepts. In the classroom, a school teacher used Multiplayer Educational Gaming Applications or (MEGAs) to teach her science class about genetics. The MEGA was introduced to the students as a review of genetics material covered and all 129 students received normal instruction prior to playing the game. The experimental group played the MEGA and the comparison group reviewed the material via independent paper and pencil practice as well as whole group discussion. The MEGA covered student understandings of pedigrees, Mendelian inheritance, blood types, and DNA fingerprinting through a problem-based crime scene investigative mystery. The mean report card grades for both groups was not statistically significant, as both groups did about the same on the exam with the control group edging out slightly. However, the experimental group was significantly more engaged than control group students. The researchers here found that the game had a rich storyline but wasn't necessarily entirely skill-based, which may help to explain why results on their post-test weren't statistically better. However, the building and use of MEGA's may be a worthwhile endeavor due to limited teaching methods on such concepts such as genetics which are important for many science-based disciplines. The multiplayer component of MEGAs allowed students to interrelate while interacting with the virtual environment making games more dynamic and interesting. This notion of cooperative play lends another dimension to learning through games. (Annetta, 2009)

Another example is a medical professor who wanted to use Kahoot! to teach undergraduate medical students histology and cell biology. She also wanted to test engagement and its effects on understanding the material. Four labs of about 50 students each participated via Zoom while the professor stood in a classroom with Kahoot! on a projector. All students participated in both traditional lab sessions and Kahoot! sessions to compare which they felt more engaged with and answered a short questionnaire shortly after. An overwhelming majority of students reported that they felt that Kahoot! helped them learn the material better. (Kalleney, 2020) This study differentiates from mine in that I evaluated the participants with a pre and post-test, whereas she gave them a short questionnaire asking if they would like Kahoot! to be a review tool in the classroom. Another key difference is her study compared traditional lecture with the Kahoot! via Zoom, whereas my study compares playing Kahoot! via Zoom and watching Kahoot! via Zoom.

Exogenous games provide simple networks of generic, interactive strategies useful for organizing access to a wide variety of content. They allow curriculum developers to quickly use the skeleton of an existing game and formulate it to fit any subject matter. Exogenous games have the following attributes: they are an "empty receptacle, where the learner is motivated to learn a new set of facts; the facts are "true" by the authority of the game designer; learners gain knowledge through memorization of a set of facts; instruction is taught by transmitting information effectively and "training" the right responses; the social model is dictated by the player acting alone and using outside resources is considered cheating; identity is meant to be boosted by the game developer, i.e. if the student is not motivated, it is the game developers job to create an "exciting" learning environment; and finally the game must make learning palatable. Teachers and curriculum designers have long used exogenous games, such as Jeopardy-style or Wheel of Fortune-style quizzes, to supplement a review of or a break from ordinary learning

activities. (Halverson, 2005) Examples of exogenous games include Jeopardy, Wheel of Fortune, and Kahoot!.

MOTIVATION: EYES ON ENGAGEMENT

Young people's intrinsic motivation towards games contrasts with their often-noted lack of interest in curricular contents (Prensky, 2003). Teachers have tried several methods to teach students in such a way that they will remember the content. One method that works well for a history class is movies, or short documentaries. By visualizing the subject matter, a student can imprint in their brain what is needed, so that instead of recalling information on a test from lecture notes, they can recall information they learned from watching that video. Therefore, engagement is so important. Instead of the teacher teaching, they take on the role of a coach who is asking questions when necessary, while the students take a more active role.

This is even more crucial at the university level. With COVID-19 and increased distance learning, this problem is exasperated. This is where Kahoot! comes in, to increase student engagement. To gauge engagement, we first need to understand what motivates a student. We can do this through a variety of perspectives, however here we are going to focus on the psychological and socio-cultural perspectives.

The psychological perspective is evident with the inclusion of the three dimensions of engagement – affect, cognition, and behavior – as recommended by Fredericks, Blumenfeld and Paris's (2004) comprehensive review. Affect is recognized as enthusiasm for the subject as well as a sense of belonging to the institution. Cognition refers to being flexible with problem solving, finding a preference for hard work, and positive coping in the face of failure. Behavior concerns

the observance of rules and adhering to norms. A sense of belonging also points to the socio-cultural perspective where the student sees themselves as part of the university, part of a major, or part of a line of work. A key strength of envisioning engagement in this way is that it acknowledges the lived reality of the individual, while not reducing engagement to just that. (Kahu, 2013) Because students are less likely to answer questions when the teacher asks for open-ended discussion, we can see why. Some may not want to be seen as "drawing the lecture out", or "contributing to everyone else's boredom", so they stay silent even though they might have something to say. Kahoot! removes this socio-cultural pressure by allowing students to create a username and be as anonymous as they want to be. The teacher can then facilitate more discussion after each question.

Equally important to understanding a student's motivation is their goal orientation. There are two goal orientation beliefs: intrinsic and extrinsic. Students operating with an intrinsic goal orientation are assumed to be approaching a task with a focus on learning and mastery. Students operating with an extrinsic goal orientation are assumed to be approaching the task with a focus on performance or grades or pleasing others. (Pintrich, 1992) We can work with both. Both intrinsic and extrinsic students will have a vested interest in reaching the top three of the leader board. Having said this, we can assume that the answer to moving goal-oriented students is competition.

There are some major advantages of competition in education through video games. Symmetrical social competitive gameplay is comparatively easy to include in a learning session that contains educational videogames. In this variation of competition, each player has the same resources and options, must master the same task, and must reach the same goals. (Nebel, 2016) Kahoot! is symmetrically social competitive gameplay.

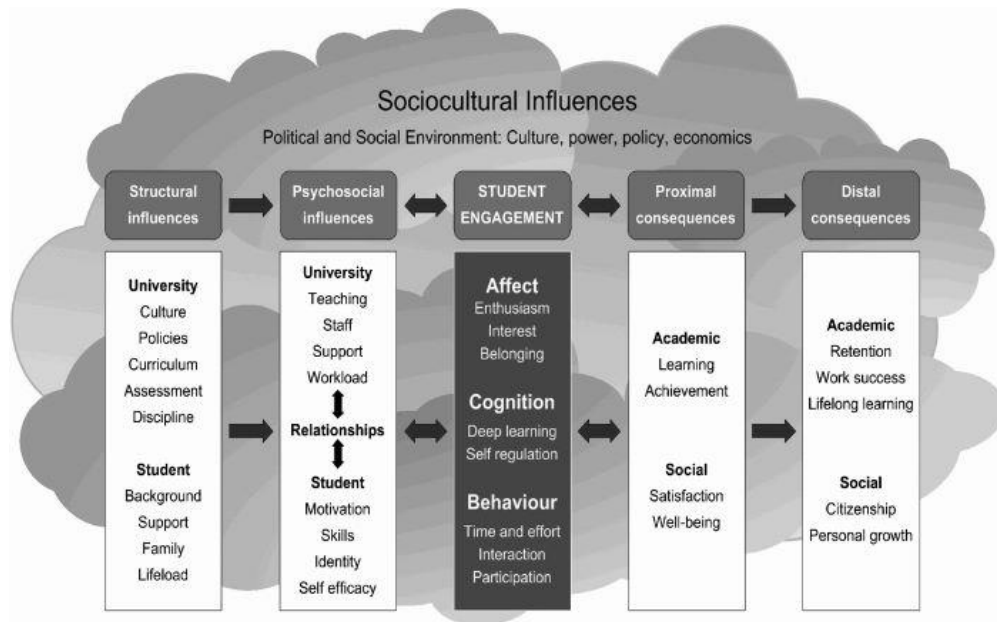


Fig. 1. Sociocultural Influences on Student Engagement (Kahu, 2013)

Tom Malone’s theory of intrinsically motivating instruction lists three categories to make things fun to learn: Challenge (goals with uncertain outcomes), Fantasy (captivate through intrinsic or extrinsic fantasy), and Curiosity (sensor curiosity through graphics and sound, and cognitive curiosity where the player should solve something unsolved) (Malone, 1980). Malone's theory was tested by a high school history teacher who used a game called Making History to teach his class about World War II. This was done by dividing the class into two teams and when an event happened in the game, the entire class was engaged and talking about how to progress outside of the classroom. Even with students that were confused as to what was going on, the professor turned that confusion into a teaching point asking, “How do you think America felt during this period of confusion?” Data collection for this study involved observation, video recorded classes before, during and after the game and focus group interviews with the students themselves. The researchers used constructivist grounded theory to identify

common themes. What they found was high levels of engagement in the room where the game was being played, but back in the classroom, the teacher was the central focus because of the way it was set up. Students were graded on the goals that were accomplished so it is still a “serious” game. In this regard, students did retain much of the information used for the final paper on World War II. (Watson, 2011) This concept worked because the teacher applied Malone's theory. There was challenge, the students would talk amongst themselves on how to further themselves in the game. There was fantasy, the classroom became the "situation room" where the students had to make decisions as if they were real decisions that would affect them and not just their avatars in the game. Third, there was a sense of curiosity. The visuals kept them engaged and the students were interested enough that they discussed the game outside the classroom. This is what educators want, for a subject to be so enthralling that the classroom no longer becomes just a classroom, but an environment for cognitive growth, learning, and most importantly, fun.

REWARD-BASED LEARNING

The idea that positive stimuli leads to an "approach" whereas negative stimuli leads to an "aversion" is the basics of operant conditioning. At a basic level, motor movements are important to acquiring positive outcomes and that learning from reward-related experiences can reinforce the production of preceding movements. (Madan, 2013) Kahoot! uses a point system. Each correct answer leads to a higher score. Kahoot! is also unique in the fact that the faster you answer, the more points you receive. The top three scores appear on the podium at the end of the game. The rewards-based learning theory would state that students would be more engaged because they have a vested interest in acquiring points by getting the correct answers, leading to

more focused students. Seeing a red screen with the incorrect answer would be an aversion to students because it would lead to negative reinforcement. A researcher, Wang, also found that audio made a significant impact as a positive stimuli. Wang measured four experiments: the first was the Full Kahoot! experience with audio and points, the second was points only, no audio, the third was audio only, no points, and the 4th was no audio or points. Their observations can be found below:

- Full Kahoot!: High spirit in the classroom, laughter, focused students, loud discussion between the questions in the quiz, loud cheering when getting the correct answers, some students started to dance in their seats, and there were open questions to the teacher during and at the end of the lecture. The class was highly responsive.
- No audio: Quiet classroom, concentrated students, no cheering, no discussion among students, and no questions during the lecture.
- No points: High spirit in the classroom, laughter, quiet cheering when getting correct answers, some discussions between questions, open questions during the lecture, and some students were dancing in their seats.
- No points/no audio: Low energy in the classroom, totally quiet, no celebration on correct answers, low response, and no open questions from students. (Wang, 2016)

From these results, we can see there is something to reward-based learning. Even if we do not have results for how these students did on the following test, we can see that audio stimuli and the point system working in conjunction lead to students having fun and being more engaged with the following lecture after.

ON THE SUBJECT OF LIMITED CLASS-TIME

Some teachers may be understandably hesitant about using games in the classroom. Some potential problems that may arise are:

While these are all valid reasons, the teacher must decide if the opportunity cost for the benefit of increased engagement outweighs these risks. Simkin did a similar study using Jeopardy!. He chose ten questions from an earlier computer programming final exam from the Fall semester and included variations of those questions in the game of Jeopardy!. The game was performed in the Spring semester for a new group of students, who were alerted that they may "see those questions again". Simkin found that the test results between the two groups of students was negligible, the group who participated the Jeopardy! game was more focused and had a more positive reception of the material. The teacher did not feel that it significantly altered his lesson plans, but this study was performed only once in the fall semester and repetitively in the Spring semester. No students mentioned the game as a positive or negative aspect of the class, meaning it may have been a one-off review tool and not as important to students. (Simkin, 2013)

Kahoot! is simple to understand, in that clicking on the color of the desired answer choice is the basis for how to play the game. Technical issues could possibly be the biggest problem, due to having to rely completely on Zoom, Kahoot's website, and mobile phones. If strangers play the Kahoot!, it's not completely unlikely that they may still choose not to engage even with the host offering icebreakers. Nevertheless, there is a growing consensus that educators must shift from a teaching-centered paradigm toward a learner-centered paradigm. In doing this, educators engender understanding and move from memorization of facts to "deep learning". (Roehl, 2013) In other words, Kahoot! motivates them to take up challenges, able to control it,

absorb the activity, stimulating their intrinsic interest and value the session as a useful activity for learning (Ismail, 2017)

Simkin also mentions that more repetition may be beneficial to seeing results. The goal then is to mitigate the number of potential problems for the teacher while ensuring that students enjoy a seamless experience. Simkin also did not follow the Bee and Hayes model of creating a pre and post test. They found that having students take a pre and post-test before and after the Jeopardy! game significantly increased understanding of the material on the exam and that they would like to participate in Jeopardy review for future exams. (Bee and Hayes, 2004) There is debate on whether students can actually learn, or if they are just rehashing facts, but doing this study close to the actual exam for the class could be an effective review tool.

ASSAUGING FEARS ABOUT GAMIFICATION IN THE CLASSROOM



Fig. 2. Different Elements of Gamification (Loveless, 2020)

Gamification is the idea that a game can be made from anything. Teachers can use this technique to teach certain topics or train students to think a different way than they otherwise would. While some games have issues with prior knowledge and training, Kahoot! requires none of either. In fact, Plump and LaRosa (2017) found that Kahoot! was easy for teachers to use in their classroom and required no prior training to implement. Also, allowing students to use their own mobile devices to participate creates a sense of autonomy while giving them real time-feedback on their performance. (Licorish, 2018) Because Kahoot! only lasts for a short duration, not much of a teacher's lesson plan needs to be devoted to it. In fact, Kahoot! not only targets users' needs for challenge and fantasy, but also promotes students' sensory curiosity through surface-level gamification features (e.g. suspenseful music and colorful displays), and their cognitive curiosity through the problem-solving process / real-time feedback. (Plump and LaRosa, 2017) Surprised to find that not much about Kahoot! is known in the university setting, I was curious to research this area. Several studies have been performed at the elementary and high school levels, but university students have very specific measures they need to hit in order to pass an exam. The challenge then, is even if Kahoot! leads to increased engagement, can it lead to increased test scores? If there is proof that gamification leads to increased test scores, then all teachers might utilize it. An interesting question posed for future research is whether there are long term memory benefits to gamification, or if it starts to fizzle out with repeated use or no use, should the teacher decide that the novelty has worn off. (Papastergiou, 2009)

LOGISTICS

The COVID-19 pandemic made in-person testing not feasible, so the study needed to be administered over Zoom. The pandemic has brought about a new set of challenges, but none

more so than the continuity of education for our youth. The past decade has witnessed a dramatic increase in the development of e-learning systems and technologies. The use of e-learning, as a support for more traditional methods, is now a major trend in higher education and blended learning (a balanced mix of e-learning and classroom instruction) is now more important than ever, with Zoom leading the way in video conferencing. (Yen, 2011) This is where the study differed from the ones that came before because the study was done virtually with university students. Among nearly 3,000 colleges in the United States, only 10% had plans to offer complete online instruction for Fall 2020, with the remaining 34% of institutions running primarily online, 21% in hybrid format, 23% primarily in person, and 4% fully in person. Fall 2020 and Spring 2021 trends show an average increase of enrollment as primarily online institutions with a 7% increase compared to 5% in Spring of 2020. Globally, 66% of teachers report receiving additional training and instruction regarding remote learning. 42% of students indicated staying motivated was a major problem for them completing coursework online, while 37% said it was a minor problem. (Miller, 2021)

As we can see, the pandemic led to almost total reliance on remote learning and the online learning industry is projected to pass \$370 billion by 2026. Neither teachers nor college students were prepared to move completely online. With nearly half of students citing motivation as a major problem, teachers need to keep students engaged becomes more crucial than ever before, which is why this research is so cutting-edge. Not only did we observe a new population of students, that had not been well-established on this topic, but we also introduced the variable of virtual testing on the participants. Fortunately, participants were able to log into the Kahoot! using a PIN number on their cell phone, tablet, PC, or any device has internet capability, so no

additional equipment was needed. The reality that virtual learning is becoming more and more necessary in education makes these results a welcome boon.

METHODOLOGY

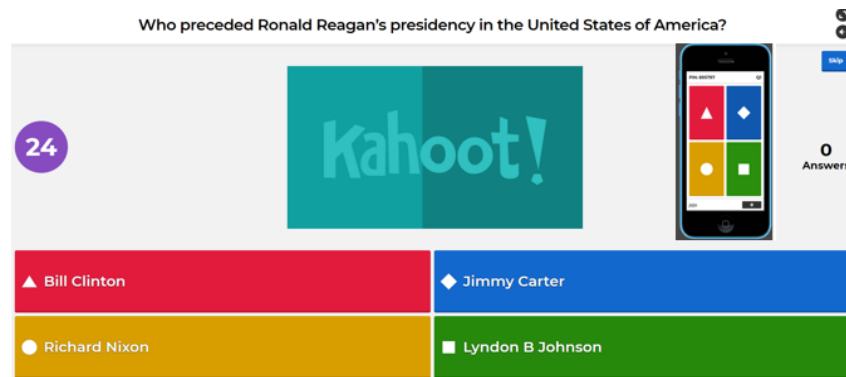


Fig. 3. Kahoot! can be played on multiple devices

CREATING THE KAHOOT!

Kahoot! is an online video game that anyone can create an account and start creating “Kahoot!s”. The free version allows the user to enter in a question at the top, then choose if they want to frame the question as four choices to choose from or frame it as a True or False question. Each question will time down until either time is called or all participants submit their answer. Then a bar graph will show how each participant did on the question. Players are awarded points based on each correct response and how quickly they chose the correct answer. So, two players could both receive the correct answer, but whoever answered more quickly would receive higher points. At the end, the 1st, 2nd, and 3rd place players show up with their scores on a “podium” or leaderboard. All questions are educational in nature. To prevent a situation where participants

could simply use process of elimination or easily remember ten questions, I created approximately forty questions. The questions are based on a standard high school education in the core subjects of math, English, social studies, and science. These are generalized questions that all university students should have a common knowledge of, and the goal is to test general knowledge for university students of all disciplines on K-12 material based on Michigan state educational standards.

THE PRE AND POST TESTS

Because we are using the Kahoot! as a learning tool, the Kahoot! needed to be able to “teach”. To measure its effectiveness, we developed a pre and post-test to gauge knowledge before playing the Kahoot! and after playing the Kahoot!. In order to have a fair assessment, each student was given eight minutes to complete each test before and after the Kahoot!. The pre-test was all short answer because we wanted to gauge participants understanding of concepts before we introduced them to the subject matter that would be on the Kahoot! This could be revealing in that their level of education could create a foundation on which to build upon after the Kahoot! A disclaimer on top of the pre-test asked the participants to please refrain from simply “looking up” the answers. After the Kahoot! was played, the post-test was taken. Post test questions were multiple choice and short answer. Only some of the post-test questions will have been on the pre-test and other questions were added. The most important part of the pre and post tests was to gauge if participants had a better understanding of subject material from playing the Kahoot! Throughout the pre-test, post-test, and Kahoot!, various “vocabulary words” appeared.

A vocabulary word is another way to gauge what the participant learned from the Kahoot! by familiarizing them with terms they may have been unfamiliar with prior to.

LET'S PLAY KAHOOT!

Group A and Group C were the experimental group. Group A was four university students that did not know each other, and Group C was a group of eleven of university students that did know each other. After the pre-test, I explained the rules for our Kahoot! game, which were not discussing the answers, no discussing politics, and above all else, having fun. The students logged into the Kahoot! website from their cell phone and chose unique usernames. During the Kahoot! with Group A, I attempted to create some icebreakers with the students to get them to talk to one another. This deflated quickly, so we moved along with the questions. Group C included lively participants, who not only responded to my icebreakers, but began talking to each other about the questions and the effect of education on their lives. After the post-test and follow-up, I found that early results were conclusive, that both Group A and C did better on the post-test than the pre-test. Group C was significantly more engaged. I found the results to be about the same, but it did introduce a new variable into this experiment. What was the likelihood of increased results when comparing strangers versus friends? Does the social interaction between friends lead to better engagement and increased test results? While I found from my small groups that social engagement could have a positive effect on remote learning, I was left wondering what I could achieve with a larger sample size.

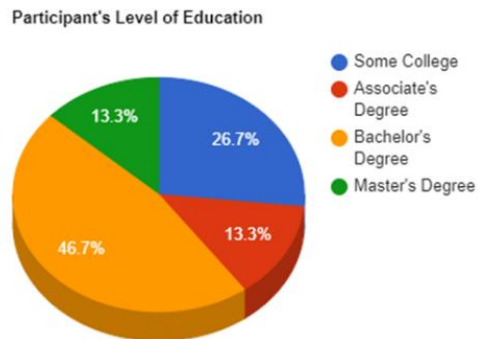


Fig. 4. Level of Education

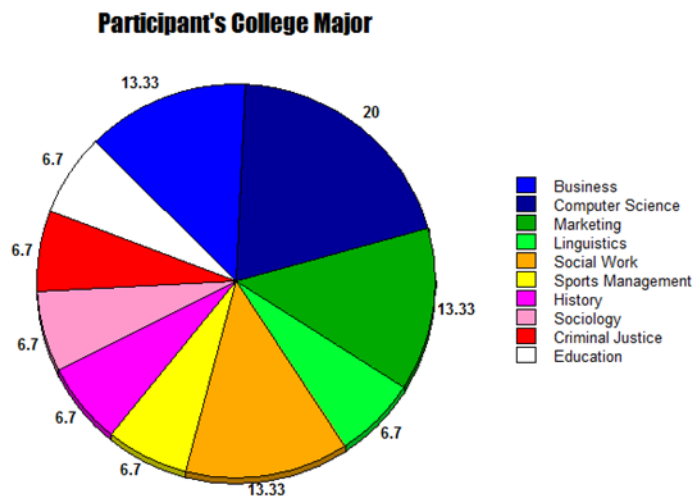


Fig. 5. Spread of college majors

THE CONTROL STUDY

To have data to measure against the experimental groups, we developed a control study in which participants that were not chosen to play the Kahoot!, would instead watch a video of a

small group of students play the Kahoot!. I did this to further my hypothesis that engaging with the Kahoot! is pivotal to the overall retention of information. This recording did not detail information about the students and these students did not participate in the study at all, but they were aware that they were being recorded for the control study that would eventually take place. Participants were selected at random to be in either the experimental or control groups and they were playing (or watching) the same Kahoot! questions. Seven students were present for the control study. These students were known as Group B. There was no communication between the students and one person had difficulty with the video buffering, but overall, the time it took to perform this study was about the same as those who did play.

Afterwards, I emailed these students and asked if they felt that they would have been more engaged had they been able to play the Kahoot!. All of them said yes that they felt that playing the Kahoot! would have improved their score on the post-test. One student mentioned that had this been an actual class, she would have been bored and distracted. The results for this study reflected the students' responses, meaning they were very "middle of the road" when it came to engagement.

Group B had the highest improvement rate with the mean pre-test score being a 54% and the mean post-test score being an 89%.

THE FOLLOW-UP SURVEY

After testing concluded, we asked the participants to participate in a follow-up survey. The first question on here contained the only identifiers needed for the research, which were their major and their line of work. After that, we asked about their confidence level on the pre-test,

their ability to understand what was being asked of them on the Kahoot!, their sense of desire in being one of the names on the leaderboard, whether there were any technical problems, their confidence on the post-test, whether or not they felt the Kahoot! influenced their ability to perform effectively on the post-test, and whether or not they had heard of any of the vocabulary words prior to their experience playing the Kahoot!.

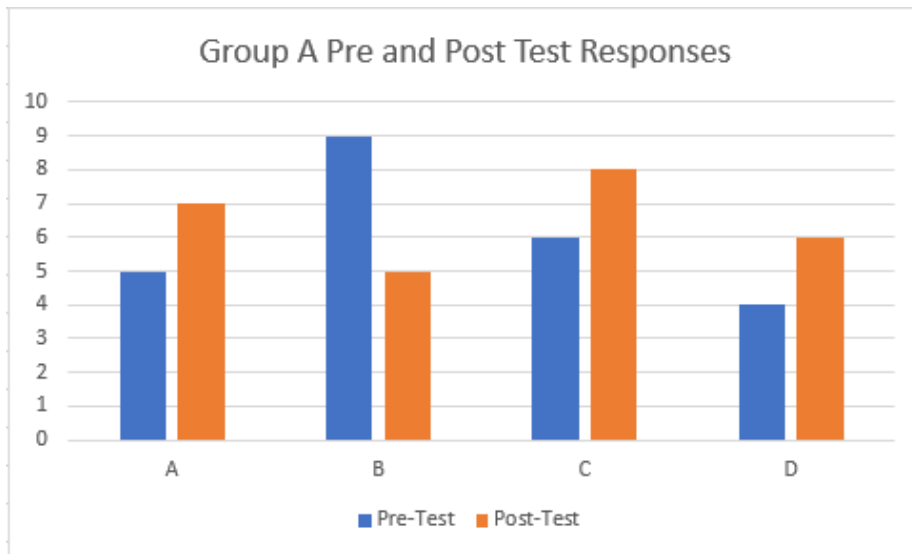


Fig. 6. Group A confidence responses (4 participants labeled as columns A through D)

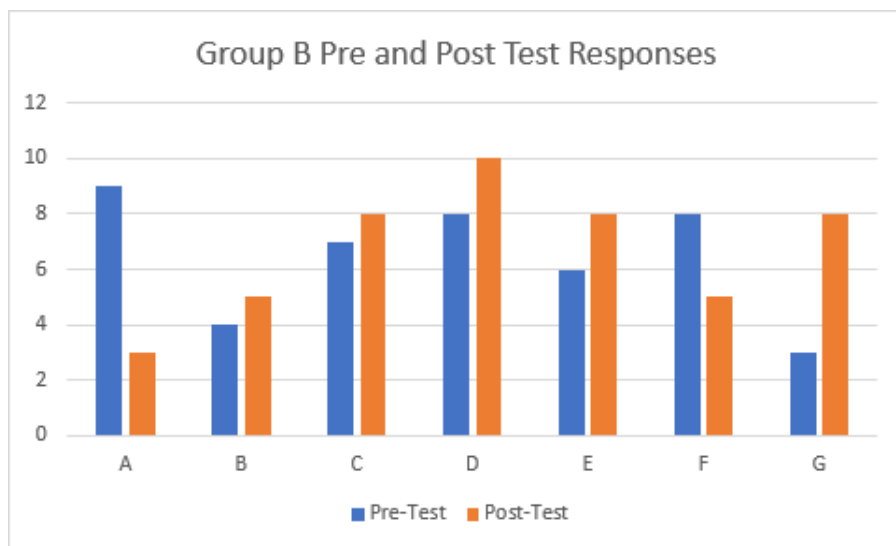


Fig. 7. Group B confidence responses (7 participants labeled as columns A through G)

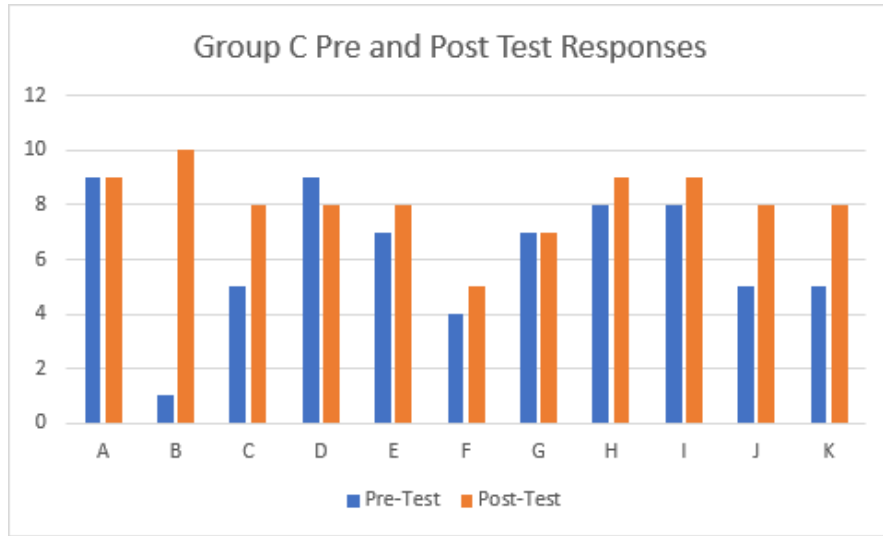


Fig. 8. Group C confidence responses (11 participants labeled as columns A through K)

RESULTS

The follow-up survey provided valuable data as to the mindset of the participants as the study progressed. We asked the participants how confident they felt in answering questions on the pre-test and post-test on a scale of 1 to 10, with 10 being "very confident" and, 1 being "not confident at all". As shown in figures 4 through 6, the responses show on average that after playing the Kahoot! the participants felt more confident. Out of 23 participants, only 4 said their confidence level dropped after playing the Kahoot!. In addition to this, later in the survey, the participants were asked how they felt the Kahoot! helped them perform on the post-test. This was also answered on a scale of one to ten. 10, meaning the Kahoot! definitely helped and 1, being they felt it did not help at all and they would have done the same on the post-test regardless of their experience with the Kahoot!. For Group A, 3 out of 4 participants reported an increasing trend. 75% of them found playing the Kahoot! was helpful to succeeding on the post-test. With Group B, 5 out of 7 participants reported an increasing trend. 71% of the participants found that watching the Kahoot! helped on the post-test. Finally, Group C, 8 out of 11 reported an

increasing trend. 72% of the participants found that playing the Kahoot! helped on the post-test. 2 out of 11 reported no change in opinion, and 1 participant felt the Kahoot! didn't with the post-test. What this shows is that 20 out of 23 participants felt the Kahoot! helped them do better on the post-test.

In looking at the results from the Kahoot!, I found that the participants did not act purely intrinsically or extrinsically, but acted with both goal orientations in mind. For example, when asking the participants which was more challenging, answering the most questions correctly or earning the most points, 9 out of 14 participants that played found it more challenging to get the most questions correct, while the other 5 found getting the most points more challenging. Both were extrinsic in focusing on performance, but a slight majority had more of an intrinsic goal orientation, focusing on learning and mastery of the subject material. This is curious because even when the game is being played, the majority of participants were focused on the mastery of the questions, even with the challenge of trying to score the most points and moving quickly. This provides evidence that gamification can make learning fun, while not completely taking away from the learning material. In fact, the competitive nature of Kahoot! led to participants answering the question about having a desire to be at the top of the leaderboard answering in the affirmative. In Group A, 3 out of 4 participants were motivated by the leaderboard, and in group C, 7 out of 11 were motivated. All participants from Group B that answered yes mentioned that if they had actually played the Kahoot!, they would have been competitive. When I asked these participants after the study if they felt like playing the Kahoot! would have positively affected their results on the post-test, all of them said yes. The amount of engagement they felt was significantly less than their counterparts in Group A and C. While their test results, shown in Fig.

9, were still positively impacted by the Kahoot!, participants agreed that playing would have increased their attention to the subject matter.

Something that we wanted to make sure we covered with the study was making sure that our participants came from a variety of college backgrounds. Looking at figures 7 and 8, we can see the participants have a wide variety of college experience and majors. With the population of the study being diverse, we can see that no matter what discipline a university student chooses to follow, broad subject matters do not significantly affect the outcomes. About half of our participants obtained their bachelor's degree, however, we were able to reach students from computer science to marketing, and sports management to sociology.

	Group A	Group B	Group C
Pre-test	57%	54%	58%
Post-test	87%	89%	90%

Fig. 9. Mean Test Scores Group A-C

Upon reviewing the pre and post-test results, the outcomes were favorable towards the hypothesis. As shown in the figure above, all three groups did significantly better on the post-test compared to the pre-test. This table shows the average score for that group on how well they answered the questions on each test. These results show that the friends' group (Group C) did better than the group of strangers in Group A. Thus, allowing us to show that the competitive nature of Kahoot! increases the retention rate of material when the social aspect is more apparent. The most important thing that we can take away from this study is that all groups felt

that the Kahoot! strengthened their understanding of the subject material. Kahoot! was effective in teaching the subject material, having participants retain information and having better test outcomes.

FURTHER RESEARCH OPPORTUNITIES

With a rising demand for remote delivery of courses, teachers need socially engaging kinesthetic and tactile learning techniques which translate well online. My study demonstrates the potential for games like Kahoot! to fill this vacuum. Future work will improve upon the quality of questions, breadth of topics, and the sample size of participants. There is also more room to explore the strangers versus friends' aspect more, seeing just how much comfort and camaraderie can go in improving results on the post-test. My preliminary study found evidence that strangers tend to keep to themselves in a group, but that students who know each other will banter and chat about questions in a competitive setting. This is in line with AUSSE's engagement measures, as social interaction in a supportive learning environment is a conducive environment for learning. Participants are actively learning and feeling challenged while doing so.

For an expanded study I will target a larger population size at local universities. I will seek a sufficient population size to achieve at least 90% confidence with 10% margin of error. This study will feature new Kahoot! games covering a broader range of topics, new pre and post tests, and an updated follow-up survey. For example, for the control group, we used the same tests and the follow-up survey had questions about how they felt playing the Kahoot!. They did

not play the Kahoot! and this caused some confusion for them. There should have been a second follow up survey for the control group.

Zoom continues to be the medium of choice for video conferencing, but with a full-fledged fixed study, a stronger recruitment drive from all over the state would be helpful towards reaching the desired sample size. In Kalleney's Kahoot! study, she mentioned in her future work section while "Kahoot! was effective in learning histology and biology, this belief must be generalized to other subjects with further research. Empirical research to investigate the effectiveness of Kahoot! as an assessment tool on students' learning achievements and performance should be done". (Kalleney, 2020) I would like to follow up on her observation in this new study.

Another opportunity for further research would be investigating the effects of game-based learning on short-term and long-term recall. Our study shows the effects that game-based learning has on short term recall. However, we do not know the effects on long term recall and if it shows as much effectiveness as was shown in this study. More research needs to be done to see if repetitive Kahoot! playing leads to better long-term recall for students.

CONCLUSION

The number of articles that have been written about Kahoot! has risen exponentially since its debut in 2012. The majority of studies have a focus on how students perceive the use of Kahoot! for learning and many of the studies focus on actual learning and classroom dynamics. The topics that are covered the least are student anxiety and teacher perceptions. (Wang, 2020) This study was aimed at covering engagement and memory retention of university students. In this paper, we attempted to alleviate teacher concerns by discussing the positives of gamification

in the classroom, as well as what motivates students on a psychological and socio-cultural level. More studies need to be done to show that gamification in the classroom can lead to higher test results, but this study is helping to show that there is promise. We need to know if repeated exposure to Kahoot! significantly improves test scores at all levels of education, or if repetition leads to decreased motivation and participation due to the loss of novelty. What we can say is that teachers who use Kahoot! can make a strong argument for increased engagement by breaking up lecture time and allowing for some friendly competition in the classroom. With a grander scale and a better recruitment drive, this study could even be the game-changer that allows students that are learning at home to do just as well as they would if they were in the classroom.

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BIBLIOGRAPHY

- Annetta, L. A., Minogue, J., Holmes, S. Y., & Cheng, M. (2009). Investigating the impact of video games on high school students' engagement and learning about genetics. *Computers & Education*, 53(1), 74-85. doi:10.1016/j.compedu.2008.12.020
- Bee, S., & Hayes, D. C. (2005). Using The Jeopardy Game To Enhance Student Understanding Of Accounting Information Systems (AIS) Exam Material. *Review of Business Information Systems (RBIS)*, 9(1), 69-78. doi:10.19030/rbis.v9i1.4471
- Coates, H. 2010. Development of the Australasian Survey of Student Engagement (AUSSE). *Higher Education*, 60: 1–17. (doi:10.1007/s10734-009-9281-2) [Crossref], [Web of Science ®], [Google Scholar]
- Fredricks, J. A., Blumenfeld, P. and Paris, A. 2004. School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, 74: 59–109. (doi:10.3102/00346543074001059) [Crossref], [Web of Science ®], [Google Scholar]
- Halverson, R. (2005). What Can K-12 School Leaders Learn from Video Games and Gaming? *Innovate: Journal of Online Education*, 1(6), september.
- Houston, A. (n.d.). Kahoot! - ED 380 Houston. Retrieved April 05, 2021, from <https://sites.google.com/site/ed380houston/home/design-and-develop-digital-age-learning-experiences-and-assessments/kahoot>
- Ismail, M. A., & Mohammad, J. A. (2017). Kahoot!: A Promising Tool for Formative Assessment in Medical Education. *Education in Medicine Journal*, 9(2), 19-26. doi:10.21315/eimj2017.9.2.2
- Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, 38(5), 758-773. doi:10.1080/03075079.2011.598505
- Kalleny, N. (2020, October). Advantages of Kahoot! Game-based Formative Assessments along with Methods of Its Use and Application during the COVID-19 Pandemic in Various Live Learning Sessions. Retrieved March 30, 2021
- Licorish, S. A., Owen, H. E., Daniel, B., & George, J. L. (2018). Students' perception of Kahoot!'s influence on teaching and learning. *Research and Practice in Technology Enhanced Learning*, 13(1). doi:10.1186/s41039-018-0078-8
- Loveless, B. (n.d.). Gamification in Education: The Definitive Guide. Retrieved December 18, 2020, from <https://www.educationcorner.com/gamification-education-guide.html>
- Madan, C. (2013). Toward a common theory for learning from reward, affect, and motivation: The SIMON framework. *Frontiers in System Neuroscience*, 7(59).

Malone, T. W. (1980). What Makes Things Fun to Learn? Heuristics for designing Instructional Computer Games. The 3rd ACM SIGSMALL symposium and the first SIGPC symposium on Small systems. Palo Alto, California, United States, ACM Press.

Miller, C. (2021, March 14). Distance learning Statistics [2021]: Online education trends. Retrieved March 27, 2021, from <https://educationdata.org/online-education-statistics>

Nebel, S., Schneider, S., & Rey, G. D. (2016). From duels to classroom competition: Social competition and learning in educational videogames within different group sizes. *Computers in Human Behavior*, 55, 384-398. doi:10.1016/j.chb.2015.09.035

Papastergiou, M. (2009). Digital game-based learning in high school computer science education: impact on educational effectiveness and student motivation. *Computers & Education*, 52(1), 1–12.

Pintrich, PR, & Schrauben, B. (1992). Students' motivational beliefs and their cognitive engagement in classroom academic tasks. *Student Perceptions in the Classroom*, 7, 149–183.

Plump, CM, & LaRosa, J. (2017). Using Kahoot! in the classroom to create engagement and active learning: a game-based technology solution for eLearning novices. *Management Teaching Review*, 2(2), 151–158.

Prensky, (2003) Digital game-based learning. *ACM Computers in Entertainment*, 1 (1), pp. 1-4

Roehl, A, Reddy, SL, Shannon, GJ. (2013). The flipped classroom: an opportunity to engage millennial students through active learning. *Journal of Family and Consumer Sciences*, 105(2), 44.

Simkin, M. (2013). Playing Jeopardy in the Classroom: An Empirical Study. *Journal of Information Systems Education*, 24(3), fall. doi:December 5th, 2020

Squire, K. (2006). From content to context: Videogames as designed experience. *Educational researcher*, 35(8), 19-29.

Wang, AI, & Lieberoth, A (2016). The effect of points and audio on concentration, engagement, enjoyment, learning, motivation, and classroom dynamics using Kahoot!. In *Proceedings from the 10th European Conference on Games Based Learning*, (p. 738). Reading, UK: Academic Conferences International Limited.

Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning – A literature review. *Computers & Education*, 149, 103818. doi:10.1016/j.compedu.2020.103818

Watson, W. R., Mong, C. J., & Harris, C. A. (2011). A case study of the in-class use of a video game for teaching high school history. *Computers & Education*, 56(2), 466-474. doi:10.1016/j.compedu.2010.09.007

Yen, J-C, & Lee, C-Y. (2011). Exploring problem solving patterns and their impact on learning achievement in a blended learning environment. *Computers & Education*, 56(1), 138–145.