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**Aspect of teaching that involves students in the learning process**

**Ernesto D. Gapasin III**

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**Name of Proponent: Gapasin, Ernesto D. III**

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**ENDORSED BY:**

**Jennyfer G. Soriano-Pactor**

**Thesis Adviser**

**APPROVED FOR PROPOSAL DEFENSE:**

**Rodrigo Jr. A. Rodriguez**

**Thesis Coordinator**

**NOTED BY:**

**Shiella I. Marapao**

**SHS Assistant Principal**

**3**

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**Abstract**

Engaging students in the learning process is an important aspect of teaching. Evidence suggests that using technology to increase student engagement and participation in the classroom is critical. This study looked into the use of technology in a high school mathematics classroom to engage students. The goal was to see if using student response systems or clickers in the classroom engaged more students than not using the technology. The second part of this study investigated whether using this technology improved student test scores. Data from classroom observations, student surveys, student interviews, quiz and test results, and the teacher's journal were used in the study.

The use of clickers to increase engagement during the class period was overwhelmingly positive in student surveys and interviews. The students unanimously agreed that using clickers made the math lectures more engaging. The teacher's journal and classroom observations provided insight into how to use clickers to promote discussion, instant feedback, and effectively implementing clickers in lectures. The results of the quiz and test were inconclusive. When comparing the results, there were far too many variables to consider, such as the students' overall math abilities. This research is critical for teachers and administrators who are looking for ways to incorporate technology into the classroom. The advantage that clicker technology provides in terms of student engagement and participation should be viewed as a supplement to the classroom.

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**Introduction**

In order to teach the current generation of students, it is critical to engage them in the learning process. “Students who interact interactively with each other and the instructor in the classroom learn concepts better, retain them longer, and can apply them more effectively in other contexts,” writes Wood. According to Stowell and Nelson, "increasing student participation is one of many strategies that may lead to improved

student learning." Today's students are referred to as the "technology generation."

It has been discovered that incorporating technology has a positive impact on academic results. Teachers must engage and increase student participation, and using technology is one way to do so. A Student Response System, also known as "Clickers," may be the tool educators require to engage students during lectures. According to Edmonds and Edmonds, "SRS technology can be used to stimulate greater learning." This can be accomplished with student participation and may be a useful tool in my high school classes.

**Definition of ‘clickers**

These devices are known by a variety of names, including classroom response system, audience response system, student response system, and simply "clickers." A clicker is a remote-control device that each student has that allows them to respond to questions in class anonymously. These devices allow students and teachers to exchange information in real time. With this immediate feedback, the results can be quickly summarized and displayed on a screen for the entire class to see. Because of the interaction between this tool and the teacher, it has the potential to improve class participation and test scores.

students and the instructor According to Lantz, the "anonymity of clicker responses appears to increase responding from students who do not normally respond in class." According to Premkumar and Coupal, "the effectiveness of this system in improving teaching and learning is dependent on whether sound pedagogical principles are used by the instructors." Educators are constantly looking for new ways to actively engage students in class, and these devices are seen as a viable tool.

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**Purpose of the study**

First, I'd like to delve deeper into the effects of SRS on student participation in the classroom by asking the following question: Are more students engaged in the class when SRS is used versus when it is not used? I believe that if students are engaged, their test scores will improve. The following question appears in the study's second section: Does using SRS not only engage my students but also improve their test scores? It will

be necessary to investigate whether there is a benefit to using this tool. The study will include the high school students they teach during the school year. They will have one Algebra II class and one Geometry class in a clicker group. One Algebra II class and one Geometry class will be in the non-clicker group. The study will last three weeks and will include a chapter's worth of instruction. They will conduct class as usual with the non-clicker group, with students raising their hands to answer questions. It is difficult to tell whether students understand the material during a traditional lecture, and they frequently leave observing their body language. Frequently, the same few students answer or ask questions in class. The SRS will be used by the clicker group to answer warm-up questions, check homework, and/or review lecture material. Checking for understanding on homework, for example, will entail a few questions that students will answer with clickers during class.

The results will be displayed anonymously on the smartboard for the entire class. They will be able to get feedback and analyze the results on whether students understand the material right away, allowing them to adjust my lecture accordingly. The adjustment may be that it is necessary to review the material from the day before to gain a better understanding. The results will be saved for a more thorough examination later. They will also be observing students in class, conducting student surveys and interviews, and comparing quiz/test results between the clicker and non-clicker groups. The information gathered through my journal will also be evaluated.

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**Summary**

Educators recognize that different students require different types of instruction. According to Milner, “handheld formative assessment technology provides teachers with a virtually real-time picture of which students need help, where they need it, and how teachers can best help.” This real-time data becomes a valuable tool in the learning

process and may motivate students to advance to the next level. “This approach helps students develop a sense of responsibility for their own learning,” Coons said. The SRS can be used as a tool to increase student participation and achievement. I'm curious to see if using SRS improves the students' learning. Will the time and effort It put into developing curriculum around SRS engage my students while also increasing test scores? I'm conducting this research not only for myself, but also to share my findings. If the findings of my study show that using SRS improves student learning, then SRS could be useful across the entire high school curriculum. If the results show no improvement in learning, then this study could save our district thousands of dollars and allow resources to be reallocated elsewhere.

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**Review of Literature**

Educators want to improve their instruction by communicating more effectively. Technology has provided numerous opportunities to improve communication. The National Council for the Teaching of Mathematics has released a report that connects research and practice. One of the research questions addressed in the report is technology and communication in the classroom. According to the NCTM, "technology" includes "any electronic tool that promotes a dynamic and interactive mathematics learning environment, allowing students and teachers to engage in calculating, representing, creating, exploring, collaborating, and communicating mathematical ideas." Secondary-level research into using Student Response System technology or clickers in the classroom as a communication tool has been limited. More research is being conducted at the university level in large lecture settings. Clickers are wireless electronic devices that consist of a student handheld responder, a receiver, and software. Students respond to questions by pressing buttons on a responder. The answers are saved on the teacher's computer for future reference. The feedback can be anonymous and displayed for the entire class to see. The studies that have been conducted have looked at four different categories. First, the literature on the use of SRS in a high school classroom will be examined. The second method is to employ SRS technology and active learning. The work that is done to acquire knowledge or a skill is referred to as active learning. The third method is to use SRS in conjunction with student and teacher reactions. It is critical to investigate the observations that students and teachers make when using clickers. The fourth method is to employ SRS and student academic test results.

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**Use of SRS in a Mathematics Classroom**

There has been little research into the use of SRS in a high school mathematics classroom. Kwan reported in the first study that "students are more motivated when they have direct involvement in their own learning and evaluation process... Students can see the results of their efforts right away thanks to CRS's feedback feature.” Over a six-week period, this action research project included students from four regular Algebra II classes in an inner-city high school, with an average of 33 students per class. SRS technology was used to supplement the lessons at the end of the lecture during the individual/group practice session and the question and answer session. Observations, questionnaires, and student interviews were used to collect data. It was discovered that anonymity encouraged participation, but that participation declined after a few weeks as the novelty factor wore off. It allows students to immediately learn from their mistakes by displaying the results and comparing answers. The anonymity feature can shield students from the embarrassment of selecting the incorrect answer. Kwan also concluded that when the clickers were used immediately following the lecture, math concepts were reinforced. Kwan did discover some intriguing information about the use of SRS. According to Kwan, overall achievement increased by an average of 59.6 percent between the pre-tests and the post-tests. According to Kwan's data, using technology may have improved student comprehension, teacher awareness of students who are struggling, and the appropriate pace of the course content. One limitation of his findings is that the test material was taught through regular lecture, which would account for the large percentage increase in test scores, while the actual effect of the SRS on student learning was not investigated. The second study, which was conducted in a high school, focused on technology-enhanced algebra instruction. In five algebra classes, Souter studied 92 ninth-grade students. This is an example of

Only ninth-grade students attend this school. There was a comparison made between traditional algebra instruction and the use of various technologies. Graphing calculators,

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PowerPoint presentations, algebra labs for computerized instruction, and online activities were among the technologies used in classrooms. Student and teacher surveys, participation checklists, observations, interviews, and tests were used to collect data. According to student surveys, they have a positive attitude toward technology. The students claimed to be motivated to learn algebra, that the classes were enjoyable, and that they wanted to succeed and get good grades. The results of the pretest and posttest confirmed student comments about having good grades. Souter discovered that “technology-enhanced classes reported a higher gain (6.6 percent) in correct answers from the pretest to the posttest.” Souter recommended that her school increase the integration of technology into Algebra classes based on her findings. The SRS technology was not integrated into the classroom, which is a limitation of this study for my research.

There has been little research into SRS technology in a secondary math class, which needs to be addressed.

**Use of SRS Technology and Active Learning**

By increasing the level of participation, students become more actively engaged in the lecture, resulting in active learning. According to Adams and Howard, SRS can help students and instructors change their behavior, which improves teaching and learning. The system can also provide useful feedback to both the instructor and the students. The SRS allows for continuous information exchange between the teacher and student, allowing for active participation in the learning process.

Eden's used SRS technology to conduct research on the teaching approach, gender, self-regulation, and goal orientation. The study included 120 participants divided into two groups. Introductory Psychology classes for undergraduates The study compared instructional approaches with and without SRS technology and discovered no difference in student achievement. This is intriguing because Eden anticipated that the metacognitive process using SRS would result in greater achievement. The effectiveness

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of SRS based on student characteristics such as gender, self-regulation, and goal orientation was discovered to play a role in achievement. While using the SRS in a lecture setting, males with low self-regulation outperformed highly self-regulated students on grades. The final finding was that using SRS influenced student outcomes such as anxiety and attendance in both positive and negative ways. Eden's conclusion is that, given the push for individual accountability, more research on SRS is needed. In addition, the instructor's goal influences the effects of SRS technology on active student learning. Wood discovered that using clickers to create a give-and-take environment increased student active engagement in class. When students responded with a variety of answers in his class, it was discovered that he would let them convince each other of the correct answer. Woods uses a biology class with 75 college students as an example of how he learned as much from them as they did from him when he first used the clickers.

He cited the benefits of answering anonymously, evaluating students' comprehension, students paying attention, and the fact that it is immediate and real-time. The effectiveness of clickers is determined by how the instructor employs them. These are all observations made by Woods, and he concluded that teaching with clickers is a lot more fun.

Tress and Jackson conducted an interesting survey of 1700 undergraduates enrolled in seven large clicker courses. The class had 200 or more students. Trees and Jackson discovered

Students were involved and engaged, and they reported a positive perception of using clickers, such as the value of feedback. They came to the conclusion that clickers are a tool that may facilitate active student engagement but do not guarantee it. Student expectations of a large lecture class, as well as how the instructor uses the tool, are important factors in active learning. The study's limitations included the fact that the survey was administered at the end of the semester and that no ongoing assessment data

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was available. Furthermore, the open-ended questions at the end of the survey suggested that the survey instrument needed to be refined. Osterman recommends the use of SRS technology to combat the passive learning environment of a lecture and promote active learning (2007). The use of SRS technology in library instruction was investigated in order to increase student active participation. It was concluded that SRS aids in maintaining students' concentration and interest by segmenting the lecture. The disadvantage may be that less material can be covered due to the time required by SRS, and technology issues may distract instructors from their teaching.

**Use of SRS Technology and Student/Teacher Reaction**

According to Kenwright, using clickers in the classroom is a good way to determine the students' prior knowledge before the lecture. It is a method of introducing the lecture topic. It is also used to determine the students' understanding of the topic being taught right away. Kenwright discovered that it allows all students to answer questions and participate. There must be a balance struck between using the clickers and introducing new material. Kenwright suggested that if used for math problems, don't just show the answers; instead, provide instructions on how to solve the problem for the learning process to take place.

Kaleta and Joosten conducted interesting research on the use of clickers on four University of Wisconsin campuses. A survey was conducted to assess people's perceptions and attitudes toward clickers, as well as the impact of using clickers on retention and grades. There were 27 instructors who responded, as well as 2,684 students. The survey had 68 questions on a five-point Likert scale. According to Kaleta and Joosten, "both faculty and students liked using clickers and perceived the clickers to have a strong impact on class engagement and learning." Both students and instructors reported higher levels of student participation and interaction. Clickers, according to instructors, were primarily used to stimulate discussion. Instructors liked the instant feedback feature and agreed that using clickers improved student learning.

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The data on student grades revealed a significant difference between classes. From the fall of 2004 to the fall of 2005, there was a 2.23 percent increase in students receiving a C or better. According to the students, using clickers was enjoyable. The use of clickers was recommended by both instructors and students. Hall and Swart polled 212 students enrolled in upper-level college courses. The survey included 90 students who used clickers and 122 students who did not.

The survey inquired about their participation and perceptions of classroom technology. Along with the survey, academic performance was assessed through test scores in one of the classes over the course of three semesters. Because of active learning, Hall and Swart discovered that students had significantly more positive affective responses when using the SRS technology. This technology enabled active participation in the learning process, as reported by students who supported it. The use of SRS technology during lectures to focus on questions resulted in higher exam scores than when the technology was not used. Hall and Swart reported that when every student responded and could compare their response to the overall class response, the learning environment was enhanced.

Stowell, Oldham, and Bennett investigated the use of SRS technology to combat conformity and shyness. Shyness can contribute to a student's lack of participation in class. They compared hand-raising and clicker responses to 50 contentious questions, and the experiment was videotaped for later review. In addition, the students filled out a mood and emotion survey. The study included 128 students from Introductory Psychology. Stowell, Oldham, and Bennett discovered that clicker responses resulted in greater group variability than hand-raising. This implied that students were less likely to conform to the group's opinion, revealing a greater diversity of student opinions. It was also discovered that shy students felt more uncomfortable raising their hands and preferred to use clickers. One limitation is that the 50 contentious questions posed are not representative of a typical classroom. Lantz investigated how clickers can help

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students understand and organize material taught in class. The use of clickers was deemed beneficial by the students. Lantz discovered that clickers made class more interactive, allowing students to gauge their understanding of material with their classmates and feel more involved.

Students must pay attention to what is happening in class. Students cited technical issues as one of the reasons they disliked using clickers. The students preferred the anonymity of the clickers to raising their hands to answer questions. According to Martyn, the majority of SRS research "targeted their affective benefits, which include increased student engagement, increased student interest, and heightened discussion and interactivity." Her research compared students' perceptions of active learning using clickers versus class discussion. The research was conducted at a small Midwestern liberal arts college. The study included four sections of a 92-student Introductory Computer Information Systems class. The participants completed a seven-question survey about their attitudes toward using clickers or class discussion. There were no statistically significant differences. Martyn came to the conclusion that the benefits of using clickers were less important than the teaching instruction. The instructors were the focus of a study that surveyed 498 elementary and secondary educators by Penuel, Boscardin, Masyn, and Crawford. The questions focused on three areas: first, the educators' goals for using clickers; second, the instructional strategies they used when using clickers; and third, the educators' observations while using clickers. One significant limitation is that all survey participants used the same company's technology and received a $10 gift certificate for participating. The educators stated that they intended to use the SRS to improve learning and instruction. The instructional strategies covered a wide range of topics, including assessing student understanding, using a discussion generator, and adjusting lectures. When educators used clickers, all of their observations were positive. Penuel et al. compared K-12 to higher education and concluded that teaching practices using SRS technology are the same in both settings.

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Premkumar and Coupal (2008) pointed out that this technology is only a teaching and learning tool. For learning to be improved, pedagogy must come first, followed by technology.

**Use of SRS Technology and Students’ Academic Test Results**

SRS use is an important activity in students' self-monitoring or self-assessment of their learning. The research on the use of SRS on direct academic performance has yielded conflicting results. According to Shaffer and Collura, students performed significantly better on exam questions in the clicker lecture than in the non-clicker lecture. A 177-student Introductory to Psychology course was investigated. Three of the four sections used clickers for a one-hour lecture. They discovered that participation increased in the three sections where they used clickers. When the answers to the questions from the one-hour lecture were compared, the clicker classes had significantly more correct answers. The clickers were only used to get students to talk. The use of clickers not only increased participation but also resulted in a higher percentage of correct answers, according to the findings.

Edmonds and Edmonds conducted another achievement study to see if an increase in student exam scores was related to the use of SRS technology. The research was carried out at an urban university with the help of six Introductory Managerial Accounting courses. A control group was pitted against an experimental group. It was discovered that SRS courses outperformed non-SRS courses by 3.15 percentage points on average. It is worth noting that the SRS-based courses benefited low-GPA students while having no negative impact on high-GPA students. Edmonds and Edmonds were unable to discover any negative effects of SRS on student exam performance.

One limitation is that student attendance could not be controlled, which may have contributed to the higher exam scores. Stowell and Nelson compared clickers to hand-

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raising and response card methods for student feedback in 140 undergraduate college psychology classes. The clicker group had the highest participation, but there was no significant difference in quiz scores, so it had no effect on academic performance.

**Summary**

Following a review of the literature, most of the research found that the use of SRS in the classroom was beneficial to both students and teachers. The use of SRS in the classroom to increase participation was a recurring theme throughout the study. The use of SRS encourages active learning. Teachers and students alike appreciated the feature of immediate feedback, with students.

The anonymity provided by the SRS was appealing. The actual impact on student academic performance is still unknown, and more research is needed. Furthermore, much of the research is conducted at the higher levels with large lectures, rather than at the K-12 level with smaller classroom sizes. Much more research is needed to determine the impact of SRS in the secondary classroom. With the cost of this technology declining and the student generation immersed in technology, this would be an important study to conduct.

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**Project Description**

Students today are of the fast-paced technology generation. Teachers may need to incorporate technology into the classroom in order for students to become engaged. A clicker, also known as a Student Response System, is a tool that I studied in my math class. It provides real-time data for the teacher and/or the class to evaluate. The SRS is a collection of wireless electronic devices, including a student handheld responder. Students respond to questions by pressing buttons that correspond to their responses. This technology can be used anonymously, and it has the potential to increase student participation in class and improve student learning. By comparing a non-clicker classroom to a clicker classroom, I wanted to see if using clickers in my math class makes a difference in my students' learning. They want to know if using clickers increases student engagement and thus participation, as well as if test scores improve. by observing student participation, surveying and interviewing students, comparing student quiz/test results across classrooms, and maintaining a personal journal The research provided data that was used to answer the following questions: Are more students engaged in the class when SRS is used versus when it is not used? Does using SRS not only engage my students but also help them perform better on tests? This study yielded findings about the use of SRS in the classroom that participants shared with their administration and colleagues.

**Procedural Description**

They kept a record of my observations about my participation in each of the classes. This checklist was completed daily, along with comments about student participation. I conducted a written survey and an interview with my students about math and the use of technology in the classroom in general. The survey was administered at the conclusion of the study to assess the use of this technology in the classroom and participation in math class. The study also included a review of quiz/test scores for Geometry and

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Algebra II students. The same quizzes/tests were administered in the same course, and the results were compared. For additional data, a personal journal was kept during this study. My Geometry students were assigned a chapter on right triangles and trigonometry. My Algebra II students learned about rational exponents and radical functions in a chapter. They began each class with 3 to 5 warm-up questions. Each group was given the opportunity to respond to the same questions. The non-clicker group wrote down their answers on paper, and we discussed them in class. The clicker group used the clickers to record answers, and the results were displayed anonymously on the smartboard for class discussion. They did collect answers to the questions from both groups, one electronically and the other on paper.

During the lecture, the same information was presented in each course. Students in all classes raised their hands to ask questions. To respond to my questions, the clicker class used clickers, while the non-clicker class raised their hands. All quizzes and tests were completed on paper and graded the same way. The clickers were used in the clicker group whenever possible. For example, during homework check, I had the clicker class use the clickers to record answers while the non-clicker classes raised their hands.

**Analysis**

My observations were used to evaluate the participants' participation. They developed a checklist for each class in order to determine the number of students who participated. During class, they observed each student and recorded who was participating and to what extent. The checklist was divided into four sections. First, the student has contributed to the class by asking questions or making appropriate comments. Second, the student has kept the entire class engaged by observing body language. Third, only half of the students' body language engagement was observed. Fourth, the student did not pay attention or engage in any way during class. To determine participation, they compared the numbers in the column with the different classes. At the end of the unit, each student in the clicker classes was given a survey to be evaluated. For a better understanding, I interview ten students about their perspectives on the use of clickers.

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The questions centered on students' self-evaluation of their efforts in class as well as their use of technology. This enabled me to determine whether the use of clickers resulted in increased engagement and, as a result, improved student learning. I examined the collected data for any trends or patterns that might emerge. I was looking for differences, similarities, relationships, and unusual trends. My personal journal was examined for themes that may emerge because of this research. The quizzes and tests were used to assess academic achievement. The scores were compared between the non-clicker and clicker classes. Right triangles and trigonometry were studied in seven sections for Geometry classes. A quiz covering every two/three sections was given, for a total of three quizzes. At the end of the chapter, there was a cumulative test. Both Geometry classes received the same quizzes and tests. The Algebra II classes included six sections on rational exponents and radical functions. The sections have been divided, and three quizzes will be administered. In addition, both classes received the same cumulative test at the end of the chapter. The quizzes and tests enabled a comparison of academic performance in a clicker classroom versus a non-clicker classroom.

**Summary**

It is critical to incorporate SRS technology into the classroom. The findings on whether the use of clickers influences participation and academic scores will be shared with the school district. Teachers are constantly looking for new ways to engage students and encourage them to share their ideas. This research could have an impact on how clickers are used in high school classrooms. Because there has been little research at the high school level, this is an important area to investigate.

**Result**

The information gathered is both informative and thought provoking. The data is being analyzed to determine whether or not clickers increase student engagement in class when compared to when they are not used. The data was also examined to see if the use of clickers increased student test scores. The various methods by which the data was

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collected provide a variety of insights into the use of clickers.

**Observing Student Participation**

The observation of participation checklist allowed me to reflect on what was going on in the classroom on a daily basis. The data was collected on a daily basis and converted into a percentage. Each student received a participation score for a single day as part of the process. For each score, a daily tally was kept, and a percentage was calculated for the 15 days of participation. In each category,

The following participation score was assigned:

4 - Student has participated in class by asking question or appropriate comment.

3 - Student has been engaged the entire class by observing body language.

2 - Student body language engagement observed only half of the class.

1- Student has not paid attention or been engaged at all during class.

Table 1: Observation of Participation Checklist

The following data represents the percent of students for the observation period of 15 days.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Non-clicker  Algebra II | Clicker  Algebra II | Non-clicker  Geometry | Clicker  Geometry |
| Asking questions or  appropriate comment. | 22% | 21% | 21% | 40% |
| Engaged entire class period by observing body  language. | 52% | 57% | 50% | 45% |
| Engaged only half of the class period observing  body language. | 16% | 15% | 10% | 10% |
| Has not paid attention or been engaged at all  during the class period. | 4% | 4% | 12% | 0% |
| Absent | 6% | 3% | 7% | 5% |

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The observation of student participation during the Algebra II classes was not found to have a great difference between the non-clicker class and clicker class. I believe this may be since this is an elective class, students choose this class because they want to go to college, and it is required for admissions. These students are usually juniors and seniors and realize the importance of the class and learning the material, therefore their observed participation was similar.

The observation of the students participating during the Geometry classes did have a higher percent when comparing the non-clicker class to the clicker class. There was a greater percent (12%) of students who did not pay attention or were engaged at all during the class period in the non-clicker class. This is a required class to graduate the course has a diverse set of students. Some of these students are not interested in math and they would not try the warm-up question, even after being asked to participate.

Therefore, using the clickers may have provided an incentive to participate.

I discovered when using the clickers that everyone would sign into the computer system. Also, each class would answer the 3-5 warm-up questions and I found everyone engaged from the start of class. During the lecture, incorporating a couple of clicker questions as a concept check helped keep the students‟ attention. They needed to pay attention so that they could answer the questions. The clickers encouraged students to participate because it would show the number of students who had not answered, and the students urged each other to answer. It was like a game they were playing with each other to get the correct answer. Then if someone got an incorrect answer there would be discussion on how they got that answer. The data showed 19% more students in the Geometry clicker class would be asking questions and making comments. The non-clicker class needed to answer the same questions on paper, but I was not able to see if everyone answered the questions or if they were correct immediately. I would still go over the answers but observed a much quieter class without the big discussions.

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**Student Survey and Interviews**

At the end of the study, students in the clicker classes completed a survey about their perceptions of using clickers in class. For many of the statements, the results for Algebra II and Geometry were similar. For 32 statements, students would use a 5-point scale ranging from strongly agree to strongly disagree. It was interesting to note that in the Algebra II class, 22 out of 26 students had not only heard of but also used clickers. About half of the 24 students in the Geometry class had heard of and used clickers. Again, the juniors and seniors may have used them in other classes and applied their knowledge to the statements.

The use of clickers was viewed favorably by Algebra II students. When asked if clickers helped them participate in class, 62 percent agreed and strongly agreed.

agreed; and "using clickers assisted me in paying attention in class, " 69 percent agreed or strongly agreed that using clickers improved student engagement in class. Both statements received zeros for strongly disagreeing or disagreeing. Furthermore, 77 percent agreed or strongly agreed with the statement, "prefer using clickers over listening to lectures only," reinforcing students' perception of being engaged in class. Having an interesting lecture is a big part of engaging students in class, and 92 percent agreed or strongly agreed that "using clickers made lecture more interesting." Only 16 percent agreed or strongly agreed with the statement "using clickers helped me get a better grade in this class compared to not using clickers," with 61 percent neutral. The students were unsure whether using clickers improved their grades. The perception of the Geometry students was positive. Geometry students agreed or strongly agreed with statements such as "clickers helped me to participate in class" and "using clickers helped me to pay attention in class" with 67 percent and 71 percent, respectively. The Geometry students were very enthusiastic about being able to see their answers quickly, comparing their answers with other students, and seeing how many other students got correct

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answers, with each being around 80% agreed or strongly agreed. They enjoy the clicker's competition effect. Only 21% agreed or strongly agreed that "using clickers helped me get a better grade in this class compared to not using clickers," while 54% were neutral. This is comparable to Algebra II. The survey results were generally positive, with very few people disagreeing or strongly disagreeing with the statements about the use of clickers. When asked if they would use clickers again in this class, both Algebra II (88%) and Geometry (84%) classes agreed and strongly agreed with the statement. There were even five students who selected the strongly agree option. This would indicate that students value the engagement that clickers bring to the classroom. Five students from each clicker class participated in the interviews.

The use of clickers helped them pay more attention in class, which was a common theme throughout the interviews. It gave them something to do during the lecture, which helped them pay attention and understand the concepts. They preferred anonymity because they did not want everyone to know whether or not they had correctly answered the question. On the other hand, they enjoyed anonymously comparing their answers to those of other students. The immediate feedback helped them figure out what they did wrong, and they were able to ask questions right away or get the correct answer and feel good because they understood the material. All of the students were enthusiastic about using the clickers and expressed a desire to continue using them in class.

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**Quiz Result**

I wanted to see if using clickers would not only engage my students but also improve their test scores. The results of the three quizzes and chapter test are shown in the tables below. The use of clickers and test scores yielded inconclusive results.

Table 2: Algebra II Class –Non-Clicker Class Quiz and Test Results.

Table shows percent who received that grade based on 23 students.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grade | Quiz 1 | Quiz 2 | Quiz 3 | Chapter Test | Average for Chapter |
| A | 13% | 26% | 65% | 47% | 37.75% |
| B | 26% | 35% | 13% | 22% | 24% |
| C | 26% | 13% | 0% | 18% | 14.25% |
| D | 26% | 4% | 18% | 4% | 13% |
| F | 9% | 22% | 4% | 9% | 11% |

Table 3: Algebra II Class –Clicker Class Quiz and Test Results.

Table shows percent who received that grade based on 26 students.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grade | Quiz 1 | Quiz 2 | Quiz 3 | Chapter Test | Average for Chapter |
| A | 8% | 15% | 38% | 27% | 22% |
| B | 38% | 35% | 23% | 38% | 33.5% |
| C | 8% | 27% | 19% | 4% | 14.5% |
| D | 27% | 8% | 12% | 23% | 17.5% |
| F | 19% | 15% | 8% | 8% | 12.5% |

The Algebra II non-clicker and clicker classes show that the non-clicker class has more as by more than 15%. On average for the chapter, the clicker class has 9.5 percent more Bs than the non-clicker class. Many factors could influence these figures, including the academic level of the students and students who are anxious about quizzes and tests. According to these findings, clickers had no effect on student academic performance in Algebra II classes.

Table 4: Geometry Class –Non-Clicker Class Quiz and Test Results.

Table shows percent who received that grade based on 24 students.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grade | Quiz 1 | Quiz 2 | Quiz 3 | Chapter Test | Average for Chapter |
| A | 75% | 29% | 33% | 38% | 43.75% |
| B | 17% | 13% | 17% | 29% | 19% |
| C | 0% | 0% | 12.5% | 12.5% | 6.25% |
| D | 4% | 17% | 12.5% | 8% | 10.375% |
| F | 4% | 41% | 25% | 12.5% | 20.625% |

Table 5: Geometry Class –Clicker Class Quiz and Test Results.

Table shows percent who received that grade based on 24 students.

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grade | Quiz 1 | Quiz 2 | Quiz 3 | Chapter Test | Average for Chapter |
| A | 42% | 21% | 59% | 50% | 43% |
| B | 29% | 17% | 21% | 29% | 24% |
| C | 21% | 8% | 8% | 13% | 12.50% |
| D | 0% | 33% | 4% | 4% | 10.25% |
| F | 8% | 21% | 8% | 4% | 10.25% |

There was no difference in the As for quiz and test average scores in the Geometry classes. The clicker class did have 5% more Bs and 7% more Cs, with 11% fewer students failing for the chapter average. The clickers may have aided the lower-achieving student in this case, but many factors contribute to these results. Overall, there was a difference in test scores for the Geometry class when comparing the clickers to the non-clicker classes for the B, C. This is an area that should be looked into further. There are numerous factors that can influence quiz and test results. The use of clickers to engage students and raise test scores may benefit the average student.

**Conclusions**

It is critical for teachers to engage students in the learning process, and one way to do so is through the use of technology. Students today are of the technology generation, and they expect instant feedback on their work. My high school math class is no different. This new technology would bridge the gap between a traditional math class and students' interest in using clickers in class. It is critical to engage students through their areas of interest, and clicker technology does just that. In a secondary school math class, the research involving the use of clickers is limited.

A large portion of the research is conducted at the university level in large lecture halls. The use of clickers in the classroom has been found to be beneficial to both students and teachers. Throughout the study, the central theme was that using clickers promoted active learning and participation in the classroom. Data from various sources were used to address the increase in classroom participation. The use of clickers has yet to be proven to influence student test scores. This study is significant because there has been little research on the use of clickers at the secondary level.

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**Discussion of Result**

They were surprised at how well the use of clickers was received. Students were ecstatic about using clickers on a daily basis. This tool did increase class participation. All students in the clicker classes would log into the system and answer questions. The class would keep track of itself by ensuring that the proper number of students logged in and that everyone answered the questions. It was fascinating to see how the use of clickers promoted discussion among the students.

They would not only want the entire class to get 100 percent, but they would also discuss why someone did not.

The incorrect answer was chosen or entered. This resulted in the creation of a new learning environment. Students were learning from the mistakes of their peers. Because the students were anonymous, no one knew who answered which questions. I could always figure out who was having difficulty and assist the student during homework time. My students treated this technology as if it were a game, and they were eager to succeed. The immediate feedback on how they performed individually and as a class was intense at times. There was a lot of discussion and disagreements when working with a partner to solve a math problem. This tool proved to be an excellent way for students to learn to collaborate. Through this study, I discovered that using clickers increased my students' engagement in class. The impact of clickers on test scores is still being debated. The results did not indicate that clickers had any effect on scores. When I compared clicker to non-clicker classes, the results were very close. I believe there were too many variables influencing test scores to reach a sound conclusion. I believe that using clickers would have resulted in greater success and impact on test scores for the average Geometry student. Overall, I was unable to determine whether or not clickers had an effect on test scores based on my research. As a result, more research in this area is required. They underestimated the amount of time clickers would take during class. When you let students answer the question, everyone finished at different times. Some

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students experienced downtime as they waited for classmates to respond. In addition, the total time added to the lecture averaged 12 minutes. Time is taken away from class work when you only have a 50-minute class period. The students didn't seem to mind the extra time, and the use of clickers may have aided their comprehension of the material. They would like to see more research done in this area. Do clickers or traditional lecture help students understand the material better?

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Appendix A Observation of Participation Checklist Class Hour

The Interaction of Student Response Systems in a High School Mathematics Class

4 - asking questions or appropriate comment

3 - engaged entire class period by observing body language

2 - engaged only half of the class period observing body language

1 - has not paid attention or been engaged at all during the class period 0 - absent

**Students Name** Day 1 Day 2 Day 3 Day 4 Day 5 Comments

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Appendix B

Perception of using Student Response Systems (clickers)

|  |  |  |
| --- | --- | --- |
| Had you heard of clickers before this class? | YES | NO |
| Had you used clickers before this class? | YES | NO |

Please respond to each statement by circling one of the following:

SA – Strongly Agree A – Agree N – Neutral D – Disagree SD – Strongly Disagree

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| I like math. | SA | A | N | D | SD |
| Math is important to me. | SA | A | N | D | SD |
| I often raise my hand to ask math questions. | SA | A | N | D | SD |
| I am likely to answer questions during traditional lecture. | SA | A | N | D | SD |
| Clickers helped me to participate in class. | SA | A | N | D | SD |
| Using clickers helped me to pay attention in class. | SA | A | N | D | SD |
| Clickers helped me get instant feedback on my answers. | SA | A | N | D | SD |
| Clickers have been beneficial to my learning. | SA | A | N | D | SD |
| Using clickers helped me get a better grade in this class | SA | A | N | D | SD |
| compared to not using clickers. |  |  |  |  |  |
| I learn more using clickers than not using clickers. | SA | A | N | D | SD |
| I study and prepare more when we use clickers in class. | SA | A | N | D | SD |
| I prefer using clickers more than listening to lectures only. | SA | A | N | D | SD |
| I prefer to be anonymous in classes. | SA | A | N | D | SD |
| I like to quickly see if my answer is right or wrong. | SA | A | N | D | SD |
| With clickers, I like to see how many other students got the correct answer. | SA | A | N | D | SD |
| With clickers, I like to compare my answer with other students. | SA | A | N | D | SD |
| I did not mind using clickers because no one can see my answers. | SA | A | N | D | SD |
| Getting feedback on my ideas helps me learn better. | SA | A | N | D | SD |
| Participation with clickers improved my understanding of the math topic. | SA | A | N | D | SD |
| Participation with clickers increased my feelings of belonging in this class. | SA | A | N | D | SD |
| Participation with clickers increased my interaction with the teacher. | SA | A | N | D | SD |
| Participation with clickers increased my interaction with other students. | SA | A | N | D | SD |
| I am more likely to answer questions using clickers. | SA | A | N | D | SD |
| Clickers were helpful in understanding the material. | SA | A | N | D | SD |
| Using clickers produced more overall interaction in the classroom. | SA | A | N | D | SD |
| Using clickers made lecture more interesting. | SA | A | N | D | SD |
| Using clickers enhanced the clarity of examples. | SA | A | N | D | SD |
| I enjoyed participating in class with the clickers. | SA | A | N | D | SD |
| Using clickers provided a smoother transition to the answers. | SA | A | N | D | SD |
| Clickers were fun to use in class. | SA | A | N | D | SD |
| I would like to use clickers in all my other classes. | SA | A | N | D | SD |
| I would recommend using clickers again in this class. | SA | A | N | D | SD |