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Capstone Research Paper

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Head for the Exits: The Effectiveness of Using Plickers for Daily Exit Ticket Assessments in a

Middle School Mathematics Classroom

Part I: Introduction to Exit Tickets

"How do I get students to retain the content?" It's a question that teachers have been

asking themselves ever since the beginning of time. And ever since, teachers have tried to

develop strategies that allow students to retain and recall content over a long period of time. To

help students retain information, it is necessary for teachers to give students time in class to

reflect on the newly learned content. In today's day and age, this task is becoming increasingly

daunting. With 45-minute classes for students to review the previous day's content, learn new

content, and practice the new content, students are not afforded enough time to absorb and make

sense of the new content. This means that it is imperative for teachers to give efficient, rich tasks

that allow students to reflect on the new content.

An increasingly popular active learning strategy that math teachers are implementing into

their lessons which allows students time to reflect on each day's math content is to use daily exit

ticket assessments (or DETs). Interestingly enough, teachers can use DETs in entirely different

ways; there are many diverse ways that DETs can be implemented into lessons. Traditionally, a

DET would be given to students in the form of a small slip of paper containing one to five math

problems related to the content that students learned in class that day. Students are given the

problems to complete during the last 5 minutes of class before they are dismissed. DETs can be

graded on correctness, completeness, or not at all. However, the teacher is ultimately expected to analyze the students' responses, identify common errors, and give feedback to students at the beginning of the next class; this lies at the heart of the purpose for daily exit tickets. Regardless of how DETs are implemented, they should always be the last thing students do before leaving the class.

While DETs are being used in classrooms of all subjects, it seems DETs are becoming increasingly popular in math classrooms specifically, not only in grade school, but also at the University level. Even some curriculum developers like EngageNY have begun embedding the use of DETs within their math curriculum. However, the research behind DETs is not keeping up with the pace of their growing popularity. Surprisingly, there has hardly been any evidence-based research done on the effectiveness of specifically using DETs for assessment in math classrooms. This disproportionality between popularity and evidence could lead to a scenario where DETs are widely used and accepted, but in reality, they are not effective and do not benefit students. Therefore, it is critical to find out whether DETs are effective assessments in allowing students to reflect and retain understanding of daily math content. While there has not been a lot of research done on daily exit tickets, there has been a lot of research done on assessment in general.

This term *assessment* gets thrown around a lot in today's world of education. Teachers are told by their districts that they must *assess* their students, states are constantly developing more and more statewide *assessments*, there are college entrance *assessments*, there are national and international *assessments*, and there are even entire college courses taught on the topic of *assessment* alone. As the list of assessments seems to be increasing, it is natural for one to wonder "is all of this focus on assessment necessary?" While that is not an easy question to

answer, one can be sure that assessment *is* necessary, because it is the means by which students communicate their understanding to their teachers. It is the means by which teachers determine how well their students understand content and how they may need to adjust their instruction.

In the *Compendium for Research in Mathematics Education* compiled by Peter Kloosterman and published by the renowned National Council of Teachers of Mathematics, contributors Cai, Jinfa, and Burkhardt wrote that "assessment, in the context of teaching and learning, can mean anything from informal questioning of an individual student to testing large numbers of students with national and international assessments," (917). When educators talk about assessment, it is the formal statewide and nation-wide tests that often first come to mind. Many educators tend not to think about the informal ways that teachers can be assessing their students in addition to these grand, summative tests. It is these frequent, informal assessments that give teachers insight into how well students are understanding math concepts and how they may need to change instruction or provide feedback to students. This is where an understanding of summative assessments versus formative assessments is important to understand the value of DETs.

In short, summative assessments are assessments used to evaluate how well students have mastered content at the end of a period of learning. Examples of summative assessments include state assessments (Keystone Tests, PSSAs) and nation-wide assessments (SATs), as well as unit tests, section quizzes, and final exams. Contrarily, formative assessments are used multiple times throughout a period of learning to assess how students are making progress towards mastery of content. Formative assessments involve giving feedback to students and are used to help students improve. Examples of formative assessment include observing student body language, verbally questioning students, class discussions, and quizzes (used throughout a unit).

In the *SAGE Handbook of Research on Classroom Assessment*, Paul Black describes the distinction between summative and formative assessment as this; "any assessment is merely a means to gather evidence about learning. It is the use of the evidence that distinguishes the formative from the summative, although of course the methods used and the interpretations of the outcomes may differ according to the uses envisaged," (172). To paraphrase Black, the way assessment data is used is what determines if the assessment is summative or formative; if the assessment results are used as final grade to let others know how well one has mastered content, that assessment is summative. If the assessment results are used to provide feedback to students and help them improve towards content mastery, that assessment is formative. Similarly, Black writes, "to serve a formative purpose, writing, whether in seat work or homework, should lead to feedback giving the student advice about the strength and weaknesses of the work and about how to improve," (171). That said, it is still possible for teachers to use an assessment that would typically be formative, as a summative assessment. Black adds that, "teachers may use open questions but then judge the responses, as correct or not, and move on rather than take up and explore these responses to develop a dialogue," (171). It is ultimately up to the teacher to provide opportunities for students to engage in formative assessments.

This distinction between summative and formative assessment leads one to consider, "are daily exit tickets summative or formative?" While there is no set-in-stone answer to this question, daily exit tickets are most often used as a type of formative assessment in math classrooms. The typical way DETs are implemented is as follows: students complete a physical DET at the end of each lesson, the teacher collects the tickets and reviews them overnight, and then the next day, teachers returns the tickets and provides feedback to students. Thus, an exit ticket used in this way would be a formative assessment. However, if a teacher collects exit

tickets, reviews them, grades them, but provides no feedback to students, these exit tickets are used as a summative assessment. While exit tickets can be used in both summative and formative ways, it is best that teachers use exit tickets in a formative way so students get feedback and are able to use that feedback to improve and retain the math.

Part II: A Fresh Approach to Exit Tickets

There is simply not much evidence-based research that exists which shows whether formative DETs benefit students; so, I decided I wanted to find out for myself how effective or ineffective DETs really are in the math classroom. I decided that I would implement DETs and collect data during my student teaching practicum in an 8th grade middle school math classroom during the Spring of 2020. As I began to consider how I might implement DETs into my classroom during student teaching, I quickly realized I would have to overcome some challenges.

Every time I have seen exit tickets implemented in a classroom, they have been in the traditional format; physical slips of paper with math problems that students complete, and teachers analyze overnight to provide feedback the next day. Of course, this traditional format for DETs presents some issues. First, traditional exit tickets are *physical* tickets that the teacher distributes to students. This means there will be class time spent on the distribution and collection of the DETs as well as time for students to complete the math problems. This also means that teachers will have to physically sort through and read DETs every night (and grade them if they chose to do so). Obviously, it is unrealistic for teachers to spend time every night preparing, reading, analyzing, and organizing responses from students' DETs. Secondly, while students are getting the opportunity to reflect on new content, they don't get immediate feedback on how well they know the content. They have to wait until the next day to get feedback from

the teacher, which, at that point, would not be as effective as giving immediate feedback. Lastly, traditional exit tickets typically only ask students to complete actual math problems. They usually don't provide students an opportunity to reflect with open ended questions. These issues don't entirely inhibit the purpose of exit tickets in math classrooms, however there are better ways DETs can be implemented that address these three issues.

In an effort to work around these issues, I began to look for a digital solution. Thus, I discovered the online assessment tool called *Plickers*. Plickers, which stand for 'paper clickers', is a (mostly free) online assessment software that allows teachers to create assessments, distribute assessments, collect responses, and grade responses all in a matter of minutes. Teachers can create question sets with up to five questions (using the free version) that can either be multiple choice (A through D), True/False, or survey questions where there's no right or wrong answers. Once teachers have a question set created, they can then "play" the set which displays each question one at a time on the screen. Thus, a SMART Board or other projector board is necessary, so all students are able to view the questions. Here's where Plickers stands out from other similar software; unlike other online assessment tools like Kahoot! or Mentimeter, Plickers does not require students to use technology to respond to questions. Instead, each student is assigned a unique, physical, Plickers card that they use to answer questions by holding up their Plickers card in a specific orientation to indicate if their answer is A, B, C, or D (Appendix A). The teacher then records student responses by scanning each student's Plickers card using the Plickers app on a mobile device (available on the App Store & Google Play Store). Questions are not timed, and the teacher can move forward or go back to previous questions at their discretion by using the mobile app.

Using Plickers for daily exit tickets in the math classroom successfully eliminates the three common issues with traditional exit tickets. Digital DETs with Plickers cuts out the need for physical pieces of paper which means teachers do not have to spend time making copies of the tickets, distributing the DETs, collecting the DETs, and returning the DETs the next day. Since Plickers automatically grades and organizes student responses, teachers do not need to spend as much time reviewing the DETs and grading the responses if they choose to do so.

Implementing DETs with Plickers also provides the opportunity for students to get immediate feedback on their answers since Plickers allows teachers to take as much time as they need after each question. Rather than waiting until the next day give feedback to students when content isn't as fresh in their minds, teachers can view student answers immediately and can address misconceptions right away. Plickers also provides an easy platform for teachers to introduce more reflective questions into DETs rather than simply including all math problems. Since teachers can add survey questions to question sets using Plickers, it is a great way to incorporate muddiest point/clearest point into DETs where students can identify which part of the lesson they understand the best and which part is still "muddy" in their minds.

While Plickers certainly has benefits and solutions to potential problems with traditional exit tickets, it is important to consider potential disadvantages that may come along with the Plickers software. Perhaps the most obvious disadvantage with Plickers is that there is no opportunity to include short answer or free response questions in DETs since students are responding with a Plickers card. Any question posed to students must have multiple choices for students to choose from. Furthermore, it is important to note that the Plickers mobile app requires a stable internet connection on the mobile device to work well. While this may not be an issue in a lot of school districts, it is important to keep in mind. Lastly, students must be

aware of their Plickers card and the teacher must be aware of their scanning camera while the

exit ticket is going on. If a student's card has already been scanned and the teacher scans over

that student's card again (even unintentionally) that answer will overwrite the original answer. It

is important for the teacher to manage how students handle Plickers cards to ensure that

unintentional answers are not recorded.

Although there is a lack of evidence-based research for exit tickets, there has been some

research done on Plickers which supports the idea that it is an effective student response

assessment tool. During the 2016 Fall semester, Michael Borst of the Occupational Therapy

Department at Concordia University Wisconsin completed a research project to assess student

perceptions of Plickers in comparison to traditional remote clicker response tools (Borst, 2016).

He implemented the Plickers in two college courses consisting of 45 occupational therapy

students. He did not use the Plickers software specifically for exit tickets but used it in place of

the traditional remote-style clickers for general classroom assessments and activities. At the end

of the semester, Borst gave all 45 students an anonymous survey to complete which asked them

questions about their opinions on Plickers. Borst discovered that, "all students strongly agreed or

agreed: that Plickers are easy to use, that Plickers make class lectures more effective, more

enjoyable, more interesting, and make students more confident about learning," and that, "98%

of students strongly agreed or agreed:…that Plickers scanning is quick, that it is easier to tell if

their answer is counted with Plickers than with the previous remote-control type clickers, and

that Plickers help them be more aware of what class material they know and what they need to

work on," (2016). Based on his research, Borst concludes that, "Plickers appears to be an

effective and economical way to improve student engagement, interest, confidence, and self-

awareness in class," (2016). Although this data was gathered in a university setting, it does

support the idea that using Plickers will be an engaging approach to implement DETs into a math classroom.

Part III: My Research – Questions and Background

When I first began to consider the potential effectiveness of DETs and Plickers, there were quite a few questions that I wanted answers to:

- Do students have confidence in the Plickers software?

- Do students enjoy using Plickers?

- What do students like about Plickers?

- What do students not like about Plickers?

- Does the use of daily exit tickets with Plickers help students become more confident about the math they are learning?

- Do the use of daily exit tickets with Plickers help students realize what they do and do not understand about new content?

- Does the use of daily exit tickets with Plickers improve student grades?

- Do students believe that doing exit tickets benefits their math learning?

To find the answers to these questions, I knew I would have to do the research and implement DETs into my classroom. Using the evidence-based Plickers software, I began my research at the Chambersburg Area North Middle School (CAMS North) in an effort to discover how DETs impact student learning.

CAMS North is one of two middle schools that are part of the Chambersburg Area School District, located in southcentral Pennsylvania. The district is the 22nd largest district in PA, with a total student population of over 9,000. During my time student teaching here, I

studied three pre-algebra classes that I taught. I chose one of the three pre-algebra classes to be

my "Experimental Class" and I used the other two pre-algebra classes to act as "Control Class 1"

and "Control Class 2" whose data I compared to the data gathered from the Experimental Class.

The Experimental Class completed DETs with Plickers while the two control classes did not

complete exit tickets at all. The Experimental Class consisted of 26 8th grade Pre-Algebra

students; 11 male students, 15 female students. Before I began my research implementing DETs

into the Experimental Class, the initial average grade of the 26 students was 88.7% with 12

students having an A (92%+), 8 having a B (83%-92%), and 6 having a C (74%-83%). There

were no students with a D or F. Control Class 1 had 26 students as well (13 males and 13

females) with an initial average grade of 86.64%. Control Class 2 also contained 26 students (18

males and 8 females) with an average grade of 81.71%. It is also important to note that there

was a learning support teacher aiding students in Control Class 2. All but 4 students had IEPs,

and they were in an additional learning support math class. Although the demographics in

Control Class 2 differed greatly from the demographics of the Experimental Class, Control Class

1 was very comparable to the Experimental Class. Still, all three of these pre-algebra classes that

were studied contained students with the lowest math ability in CAMS North according to the

previous year's state assessment results.

Part IV: My Research – Methods

Over an eight-week period (from January 21, 2020 – March 11, 2020), I implemented

daily exit tickets with Plickers into the Experimental Class. For those eight weeks, students in

the Experimental Class s completed an exit ticket using the Plickers software at the end of every

class. Each DET contained two to five questions. Each exit ticket always began with the same

survey question: *How well do you feel you understand today's content?* This question was given in each DET to provide students an opportunity to reflect on and express their comfortability with the new content. In addition to this survey question, one to four math questions were included in each DET. These questions ranged from the *Knowledge* level of Bloom's taxonomy, up to the *Evaluation* level. Examples include questions asking students to pick a vocabulary word to match a given definition, questions asking students to fill in blank(s) from a choice of words, questions asking students to identify an error in a completed math problem, and questions asking students to apply newly learned math concepts to solve problems. After students responded to each question, graphs were displayed to show the (anonymous) answer distribution. Then we discussed why the correct answer was right and I addressed any misconceptions based on student responses. I analyzed student responses after each DET and adjusted my instruction accordingly.

At the end of the eight-week implementation of DETs with Plickers, each of the 26 students in the Experimental Class completed a survey (Appendix B) on their use of Plickers and on doing daily exit tickets, similar to the survey Borst used in his Plickers research. From this survey, I was able to gather data on student opinions of both Plickers and DETs. Also, at the end of the eight-week implementation of DETs with Plickers, I analyzed student grades in the Experimental Class and compared them to grades in the two control classes. From all of this data, some exciting discoveries were made.

Part V: My Research – Exciting Results

Overall, the research data supports the idea that daily exit tickets with Plickers are beneficial to students. By analyzing the data, almost all of the research questions can be

answered in full. First, the research data supports the idea that DETs with Plickers may improve

student grades (Figure 1).

Class	Avg Grade Before 8 Weeks	Avg Grade at the End of 8 Weeks	Change in Avg Grade
Experimental Class (daily exit tickets w/ Plickers)	88.70%	90.16%	+1.65%
Control Class 1 (no exit tickets)	86.64%	85.80%	-0.97%
Control Class 2 (no exit tickets)	81.71%	82.27%	+0.69%

(Figure1)

Before implementing daily exit tickets with Plickers into the Experimental Class, the average

grade in the class was 88.7%. After the eight-week period of learning had ended, the average

grade in the class increased to 90.16%, which is just shy of an A. This is an increase of 1.65%.

Compare this to a 0.69% increase in average grade for Control Class 2, and a 0.97% *decrease* in

average grade in Control Class 1. This means that the average grade in the Experimental Class,

the class that completed DETs with Plickers, improved over twice as much as the average grade

of Control Class 2, which did not complete DETs. However, this data should be taken with a

grain of salt; there are a lot of factors that go into student grades.

While the answer to the question, "does doing exit tickets with Plickers improve student

grades," remains inconclusive, the other research questions are able to be answered from

analyzing the survey results from the survey that students completed at the end of the eight-week

period. Only students in the Experimental Class completed the survey. The survey (Appendix

B) included a list of 10 Likert style questions and two open-ended questions that asked students

what they believed were the best and worst things about Plickers. The last question asked

students to indicate the letter grade that they expect to receive in the class. While all 26 students

had the opportunity to complete the survey, it was voluntary, so some students did not answer all

of the questions.

The opinions that students expressed in this survey about Plickers and DETs are overwhelmingly positive (Appendix C). According to survey results, 100% of students agreed or strongly agreed that "Plickers is easy to use," and that, "Plickers makes class more enjoyable." It is evident that students really enjoyed using Plickers in class and they believed that Plickers cards are easy response tools to use.

Furthermore, about 88% of students agreed or strongly agreed with the statement "using Plickers at the end of each lesson helps me realize what I do and do not understand about each lesson." To paraphrase, about 88% of students thought that daily exit tickets with Plickers gave them an opportunity to reflect on newly learned math. This is a very exciting discovery as most teachers implement DETs to give students an opportunity to reflect on the new content, and based on this data, DETs are effective in doing just that. Additionally, about 88% of students agreed or strongly agreed that Plickers makes them more confident about the math they are learning, and 83% agreed or strongly agreed that completing daily exit tickets has benefitted their learning.

Although this research shows that the Plickers software is successful in engaging students, it is still beneficial to find out if there is anything that students specifically do not like about the software. Most students (23%) indicated that the worst thing about Plickers is that if they are not careful, they could unintentionally submit a wrong answer by flashing their card around by accident when the teacher is scanning. Although these students expressed their concern with this possible issue, 96% of the class did agree or strongly agree that they believed Plickers records their answers correctly.

Additionally, some students believed that the fact DETs with Plickers were graded is the worst thing (15% of the class) and others (12% of the class) believe that a sometimes-poor

internet connection and lag on the Plickers app is the worst thing. Teachers can choose to grade or not grade the DETs, and if a district has acceptable Wi-Fi, the mobile app has no problem connecting. The mobile device used during this research was connected to the internet via cellular data, which was very finicky at times. Also, about 15% indicated that they believe there is nothing bad about Plickers.

It is also valuable to learn what students really liked about the software to figure out why they were so engaged. An overwhelming portion of the class (46%) wrote that the best thing about Plickers is that it helped them learn, reflect, and/or understand the math better after each lesson. 15% of the class wrote that the best thing about Plickers is that it is fun and exciting, and 12% wrote that the easy-to-use Plickers cards are the best thing. It seems like its ease of use and the fact that it brings variety into a classroom is why students are so engaged when using Plickers.

These positive aspects that students identified about Plickers far outweigh the negative aspects that students identified. The challenges that come with Plickers can often be avoided by implementing structured procedures for using Plickers cards and by ensuring that the mobile device has a stable internet connection. These potential problems pale in comparison to the potential benefits that students get from using the software.

Part VI: Conclusions

Based on my research, all but one of the research questions I asked have been answered. From the data, one can conclude that doing daily exit tickets with Plickers in a math classroom helps students become more confident about the math they are learning and helps them realize what they do and don't understand about the new content. Furthermore, daily exit tickets help

students reflect on newly learned content, and students themselves believe that doing daily exit tickets with Plickers benefits their math learning. Based on the research evidence, there is no question that daily exit tickets absolutely benefit student learning.

Additionally, the Plickers software is an effective and engaging means of distributing daily exit tickets to students. Students enjoy using Plickers cards and they are confident that the software records their responses correctly. Students find that Plickers cards are easy to use and they find it to be an effective tool that helps them understand math better. Although Plickers does have potential drawbacks like accidental card scanning and reliance on a stable mobile internet connection, these drawbacks are usually very avoidable by being proactive.

The research does support the theory that DETs could improve student grades, however, it is an insufficient amount of evidence to conclude that doing DETs with Plickers does improve student grades. Because there are so many other factors that can impact student grades, more, deeper research is required specifically on this topic to determine what effect daily exit tickets really have on student grades.

Although all of this research shows the benefit of daily exit tickets, it is still up to the teacher to implement them effectively. It is still the responsibility of the teacher to give students formative feedback from the exit tickets. Without the feedback, DETs will not be as effective. As there still remains very little research on daily exit tickets, more research is encouraged. Perhaps one might experiment the effectiveness of DETs in a high school setting, or even in an elementary setting. Perhaps other digital tools besides Plickers could be discovered to be more effective in administering daily exit tickets. Nonetheless, this research done at the Chambersburg Area North Middle School brings educators one step closer to answering that age-old question of how to get students to reflect and retain information. I encourage any and all

secondary teachers to give these evidence-based exit tickets a try to see how their students too

can reflect, retain, and recall before they *head for the exits*!

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Appendix A (Example Plickers Card)
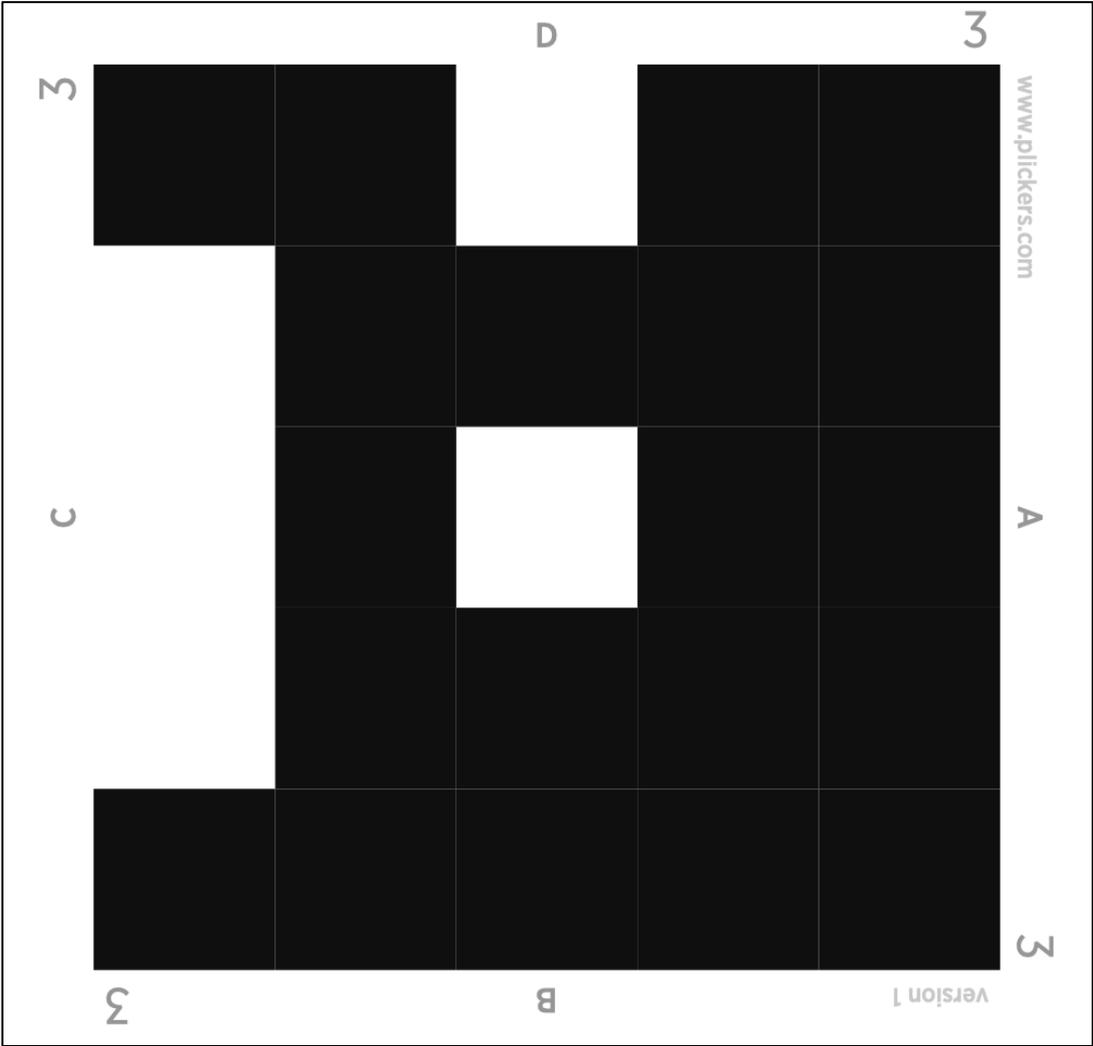
Plickers Questionnaire

1. For each of the following statements, indicate whether you STONGLY AGREE, AGREE, DISAGREE, or STRONGLY DISAGREE with the statement by placing an "X" in the corresponding box.

Statements	Strongly Agree	Agree	Disagree	Strongly Disagree
Plickers are easy to use.				
I believe Plickers records my answers correctly.				
Plickers make class more enjoyable.				
Using Plickers at the end of each lesson helps me realize what I do and do not understand about each lesson.				
Daily exit tickets with Plickers makes me more confident about what I am learning in math class.				
Completing daily exit tickets has benefited my learning.				
I believe my grade in the class has improved by doing daily exit tickets.				
Daily exit tickets would be more helpful to me if they were not graded.				
I hope other/future teachers add daily exit tickets into their lessons.				
I hope other/future teachers add Plickers into their lessons.				

2. What do you believe is the **BEST** thing about Plickers?

3. What do you believe is the **WORST** thing about Plickers?

4. What grade do you expect to earn in this class at the end of the year?
(Circle One)

A   B   C   D   F

Appendix C (Survey Results)

Statements	Strongly Agree	Agree	Disagree	Strongly Disagree
Plickers are easy to use.	22	3	0	0
I believe Plickers records my answers correctly.	11	13	1	0
Plickers make class more enjoyable.	17	8	0	0
Using Plickers at the end of each lesson helps me realize what I do and do not understand about each lesson.	9	13	2	1
Daily exit tickets with Plickers makes me more confident about what I am learning in math class.	7	15	2	1
Completing daily exit tickets has benefited my learning.	9	11	4	0
I believe my grade in the class has improved by doing daily exit tickets.	7	10	6	2
Daily exit tickets would be more helpful to me if they were not graded.	7	7	8	3
I hope other/future teachers add daily exit tickets into their lessons.	9	10	6	0
I hope other/future teachers add Plickers into their lessons.	20	4	1	0