Digging Into Student Metacognition with a Consistent Exit Ticket

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Digging Into Student Metacognition with a Consistent Exit Ticket

Chloe Fifer

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Abstract

Formative assessment is a common practice in classrooms across every grade-level. The purpose of this study was to see what happens to the test grades of seventh-grade science students following the completion of a consistent exit ticket for an entire unit with the following two questions: What was your biggest takeaway from today’s material? What test question can you write using the material from today? The author collected data through student test records, classroom documents, student surveys, student interviews, and note takings. For analysis, the author used the constant comparative method, as well as descriptive statistics. The author found the following themes after data analysis: writing test questions is hard, positive perceptions of the new exit ticket, perceptions of student metacognitive levels, a slight increase in test scores, and no change in ability to write a test question.
Digging Into Student Metacognition with a Consistent Exit Ticket

If you want to regress back to your seventh-grade science student self and play a little memory game, I invite you to say this sequence of organizational levels out loud a handful of times.

Cell → Tissue → Organ → Organ System → Organism

If you participated, I bet you could pretty easily spout off all five levels in the correct order. Our classroom of twelve- and thirteen-year-olds could too – after a couple more handfuls of recitation, of course. Repetition is the key to memorization, right? Well, arguably so, but what happens when application is introduced? Can successful repetition carry students beyond basic facts? The evident answer, in our case, was a frustrating no. Let’s continue this game and see how you do when a little bit of application is introduced. Without looking back at the top, answer the following question:

1. What is a group of tissues called?
   a. Cells
   b. Organ
   c. Muscle
   d. Collective tissues

The correct answer is letter choice “b.” How did you do? Again, I would bet you were pretty successful. Now granted, you have gone through much more education and have exercised higher levels of thinking more often than our middle school students have, but that question wasn’t that bad! However, when this question was introduced to our students about two minutes after we had recited these levels as a class numerous times, it was consistently answered incorrectly. It was incredibly frustrating, yet incredibly eye-opening. Clearly, these students
needed a way to hold onto their learning more efficiently and more concretely. This moment of realization is what prompted the design and completion of the following study.

**Purpose**

The aim of this study was to see what happens to test grades following a formative assessment strategy intervention. The research questions that drove this study were as follows:

- What happens to the test grades of general-education students in a seventh-grade science classroom when they perform the same exit ticket every day with the following two questions: What was your biggest takeaway from today’s material? What test question can you write using the information you learned today?
  - Sub question 1: What are students’ perceptions of the new exit ticket and their ability to write a test question?
  - Sub question 2: How do students’ abilities to write test questions change over time?

While this action research study was occurring, I was a graduate student participating in a yearlong clinical teaching placement in a seventh-grade science classroom at Meadows Middle School (all names have been replaced with pseudonyms). Because of this position, I wanted to see how this practice might benefit or hinder student learning for the purpose of drawing on that information in the future. Meadows Middle School is a Title 1 school in West Texas that serves a large population of economically disadvantaged students with 72% of its students falling under that category. Meadows’ student population is 19% African-American, 40% Hispanic, 36% Caucasian, and 5% Asian-American.

**Literature Review**
Formative assessment is a largely tossed around term and practice in today’s world of education – and for good reason. Its effects have been widely studied and have been found to be a beneficial tenet of the classroom (Black & Wiliam, 1998). Formative assessment is a broad theme that essentially refers to any tool used by teachers or students, while instruction is occurring, that informs student learning (Marzano, 2010). Studies examining the effects of formative assessment on student achievement are limited. However, Aydin and Ürün (2016) found that a particular type of formative assessment teaching technique significantly improved the academic performance of a group of students. Additionally, studies done by Ozan and Kincal (2018) and Vogelzang and Admiraal (2017) saw statistically significant increases in the academic achievement of a group of students who were exposed to formative assessment practices.

The “while instruction is occurring” is what separates formative assessment from the final snapshot of student learning that summative assessment provides (Marzano, 2010). This means that formative assessment can take on a multitude of faces. Marzano (2010) describes the following three categories of formative assessment: obtrusive, unobtrusive, and student-generated. Obtrusive assessment is a formal measure that stops class, such as a quiz. Unobtrusive assessments are the informal measures that happen within the flow of a class period, such as teacher questioning. Lastly, student-generated assessments are measures proposed and performed by students. My study combined the two categories of obtrusive and student-generated by incorporating a consistent exit ticket with the same two daily questions. An exit ticket, a common mode of formative assessment, is typically given to students at the end of a lesson as a way of capturing their response to a certain part of the lesson (Dixson & Worrell, 2016). Their benefit comes from the quick assessment of knowledge that not only provides the teacher with a
rough estimate of where students are in regard to handling the unit’s material, but they also provide students with a glimpse of their current levels of understanding (Dixson & Worrell, 2016). Our students had experience with exit tickets, yet not in the manner that I proposed. What they saw was a handful of multiple-choice questions that was essentially a mini-quiz, but I brought in the student-generated aspect that Marzano (2010) described in addition to the obtrusive portion that I designed. Figure 1 shows the exit ticket participants were given each day during the implementation period.

![Figure 1. Picture of daily exit ticket.](image)

Looking at the first of the two questions, the primary idea that I wanted to incorporate more into the daily learning schedule was metacognition. Generally defined, metacognition refers to a higher-order level of thinking in which one actively controls the cognitive processes involved in learning (Larson, 2009). Flavell (1979) further broke down the term into the following four distinctions: metacognitive knowledge, metacognitive experiences, goals/tasks, and actions/strategies. I made use of the second category, metacognitive experiences, within the first question of my exit ticket in an attempt to give my students a built-in metacognitive
opportunity. Özsoy and Ataman (2009) completed a study examining the effects of implementing a form of metacognitive instructional design. They found that through teaching students about metacognition and about different metacognitive strategies, students were better able to perform academically than their control group counterparts. This is an idea I took with me into the classroom. Although I was not necessarily teaching the participants the ins and outs of metacognition, I still took a few opportunities to let them in on how thinking back on what they have learned can be a valuable practice. In a similar study, Zepeda, Richey, Ronevich, and Nokes-Malach (2015) found that direct instruction on metacognitive strategies not only improved student performance, but it also increased student motivation and task value.

The second question on the daily exit ticket is what brought in the student-generated aspect of formative assessment that Marzano (2010) mentioned. For this question, students were given the task of taking the information from the day’s lesson and writing their own related test question. Sanchez-Elez et al. (2014) performed a study in which they analyzed the difference in student test performance following an intervention that involved the experimental group drafting, revising, and using their own questions as part of the unit exam. From this, they found that the experimental group did, in fact, perform significantly better on the unit exam than did the control group that did not participate in writing their own test questions. There are not a wide variety of studies done on the effects of students writing their own test questions, so this particular area is how I believe my study will most add to the existing research. Although the overarching theme of this study was to see what happened to test grades following the completion of this intervention, the second sub-question lended itself to taking a closer look at the questions students generated. It dealt with how their ability to write a test question changes over time. To judge this, I used Bloom’s (1956) hierarchy of knowledge, ranging from knowledge to
evaluation, and placed students’ questions along this continuum. I hoped to see questions move into the higher levels of his taxonomy.

Although there has been some research done on the benefits of formative assessment, none deal with a consistent exit ticket that is based on metacognition. This study will uniquely add to the body of research by demonstrating what happened after using this type of exit ticket as a formative assessment strategy. Additionally, this study will also bring depth of understanding in the areas of students’ perceptions and their ability to write test questions.

**Methods**

The proceedings of this action research study took place entirely in a seventh-grade science classroom. Although my overarching question aimed at seeing what happened to student test grades following the implementation period, I also sought information on more subtle factors, such as student perceptions of the consistent exit ticket and possible changes over time in the types of test questions students were writing. I fell along the teacher-research continuum in a unique manner, and therefore held an interesting position of authority with my students. Because my clinical teaching placement was for an entire school year, I held deep connections with my students that differed from both the traditional teacher connections and the traditional clinical teacher connections. As the sole researcher in this study, I felt that I was able to draw on this rare position and provide a more robust sense of comfort with my participating students.

**Participant Selection**

Because my research question targeted the general-education student population, the participants for this study were selected from two general-education science class periods. The number of students in these two classes was dramatically lower than the typical class size; therefore, in an attempt to increase the sample size of this study, I chose to use participants from
both class periods as my experimental group. Students from these two classes were academically similar. As a result of not having a large population size, I was forced to include a “control group” in an unconventional manner. To do so, the pre- and post-test data from a previous unit provided the control, or the basis of comparison. Therefore, the selected participants served as both the experimental group and the control group. The twenty-four students that participated were those from whom I received a signed parent consent form and student assent form. Of these twenty-four students, eleven were boys and thirteen were girls. Their ethnicity breakdowns are as follows: eleven Caucasian, two African-American, six Hispanic, three Asian, and two were two or more ethnicities.

**Data Collection**

In an attempt to cast a wide net, I collected data from a variety of sources. These sources included classroom documents, survey responses, interviews, and my personal note takings. All were done during the implementation period except for a few collected documents. In order to establish a comparison, I collected student test grades from a pre- and post-test on the unit just preceding the unit of intervention.

The data collection process can most easily be described in a chronological sense. The first thing I needed to do was establish my baseline data, which is why the scores on a pre- and post-test from a previous unit were collected. Next, the scores from the second pre-test, just before the intervention began, were collected. Then, the instruction and teaching methods for the experimental unit were kept the same, but students were given the new exit ticket following each day’s lesson/activity. The students’ responses to each day’s exit ticket were collected.

About three-fourths of the way through the experimental unit, students were given a survey, which was composed of a series of Likert scale questions and open-ended questions.
Survey responses were collected. Following the collection of the survey responses, I chose six students to interview using the purposive sampling method as described by Patton (1990). I selected two students to interview from each of the following categories as denoted from survey responses: negative perspective, positive perspective, and indifferent perspective. These interviews took place one time, lasted eight to ten minutes, and followed the semi-structured approach (Hendricks, 2017). Additionally, these interviews were audio recorded and later transcribed.

Throughout the experimental unit, I kept personal notes as a means of logging anecdotal records (Hubbard & Power, 2003). Lastly, following the intervention, I collected student test scores from the experimental unit’s post-test.

**Data Analysis**

For the analysis of the qualitative components of my data, I used the constant comparative method, which began with initial coding and was followed by the classification of major codes and sub codes (Hubbard & Power, 2003). Specifically for the coding process, I followed the guidelines proposed by Tracy (2013). For my initial coding, I went through twenty percent of my data and created level 1 codes, which are categories that simply lump similar data without much manipulation (Tracy, 2013). After I went through the remaining eighty percent of the qualitative data with these original level 1 codes, I went back through and created level 2 codes by interpreting more general themes that seemed to be conveyed by the level 1 codes (Tracy, 2013). In conjunction with the level 2 codes, I wrote memos for each level 2 code in order to better organize and familiarize myself with the interrelatedness between the codes. The codebook that I created to outline these different codes can be found in Appendix A.
The analysis of the student-generated test questions required a different approach. For this, I first took every question that each participant wrote and labeled them with a colored dot according to Bloom’s (1956) taxonomy of learning objectives. A visual of this taxonomy is included in Appendix B. Next, I subjectively analyzed these questions based on the answer choices provided and the originality and validity of the question itself. I further explain this process in the findings section titled, “What They Wrote.” The quantitative data that was collected was analyzed using descriptive statistics to find trends and areas of comparison (Hendricks, 2017).

**Findings**

From the coding and analysis process previously mentioned, I came away with three qualitative findings and two quantitative findings. My qualitative findings were as follows: writing test questions is hard, positive perceptions of the new exit ticket, and perceptions on student metacognitive levels. The notable quantitative areas included the breakdown of the exit tickets that were generated by the participants and the test score data on the pre- and post-assessments of the control unit and the implementation unit. In each area of discussion, I will include how these major themes came to be and examples of what drove them.

**Writing Test Questions is Hard**

In my original round of data analysis, it became evident that students thought the task of writing a test question was a difficult one. From my journaling notes to student interviews, it was an idea present in every area. Although this is a largely explicit idea pulled from the data, I believe it to be a foundational concept. Knowing that this was such a pervasive thought, I think it informs every other finding from this study. It was a stated factor, yet an underlying factor that drove these results.
Although a large majority of students held a positive perception of the new exit ticket, which is something I will further discuss, a small percentage had an aversion to them. The few negative perceptions of the new exit tickets stemmed, I believe, almost exclusively from the theme that writing test questions is hard. When interviewing the two students who held a negative perception of the new exit ticket, Barrett explained, “Well, I don’t really like coming up with my own questions because I get nervous, and I think my questions aren’t really that good, and the answers don’t really make that much sense.” Grace, on the other hand, when questioned about her negative perception of the new exit tickets simply stated, “It’s just hard.” Thus, the cognitive load that comes with trying to write a test question based on the day’s lesson and their inability to overlook this reality is what caused these two students to think poorly of the new exit ticket. Most students that were interviewed agreed that writing test questions was hard, yet they were still fond of and found value in the new style of exit ticket.

A facet of this finding that was unanticipated was the low amount of confidence students had for their own question. From student interviews and my journaling notes, I began to notice that students did not think very highly of the questions they were able to write. When asked how she would feel if she saw a test question that she wrote appear on a quiz or test the class was taking, Dolores claimed, “I would be shocked because, to me, I wouldn’t think that it would be a good question.” Likewise, Barrett addressed the question in the same way saying, “I don’t really know because it’s not that hard of a question, so everyone, mostly everyone, could get it right.” Because so many found the task itself to be challenging, the belief that their questions were not worthy to appear in a formal assessment seemed to follow suit. After writing a few of the better written questions from the day before on the board one day, Barrett explained that it made him feel good after he actually realized it was his question.
Lastly, my second sub question of the study dealt with whether or not students’ abilities to write a test question changed throughout the study. I was anticipating an increase in ability; however, results showed no such indication. Although most of the students interviewed claimed they thought their ability to write a test question had improved since the start of the implementation period, the breakdowns of their questions over time did not match up with this belief. This finding is discussed in further depth below. The combination of students believing it was such a challenge to come up with their own test question and the implementation period being only a unit long is what led to the answer of this sub question – that there was little to no change in their ability to generate a question.

**Positive Perceptions of the New Exit Ticket**

Going into this study, I believed that students would be drawn to the new style of exit ticket I was introducing because it was different and would not have a right or wrong stigma to it. Following the conclusion of the implementation period, I found that, indeed, most students did hold a positive perception of the new exit ticket. Survey responses indicated that 78% of students agreed to some extent that they liked the new exit ticket, and 74% of students agreed to some extent that they wanted to keep using them. Figure 2 shows a breakdown of participant responses to the four Likert scale questions they were asked regarding their perceptions of the new exit ticket.

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like the old exit tickets we did</td>
<td>4%</td>
<td>35%</td>
<td>44%</td>
<td>17%</td>
</tr>
<tr>
<td>I like the new exit tickets</td>
<td>9%</td>
<td>13%</td>
<td>61%</td>
<td>17%</td>
</tr>
<tr>
<td>I would like to keep using the new exit tickets</td>
<td>9%</td>
<td>17%</td>
<td>39%</td>
<td>35%</td>
</tr>
<tr>
<td>The new exit tickets help me understand what I have learned</td>
<td>4%</td>
<td>4%</td>
<td>48%</td>
<td>44%</td>
</tr>
</tbody>
</table>

*Figure 2. Participant survey responses.*
A minor theme that emerged under this one, which I found to be one of the most interesting from this study, was the benefits students seemed to believe came with the new exit ticket. For example, all of the students I interviewed mentioned that the new exit ticket not only helped them in Science but would also be beneficial in other classes as well. Many from the interviewed group also mentioned that being able to write down what they learned helped them understand it better and think about it more successfully. When asked why she liked the new exit ticket, Sharla explained, “Because it can make me think about what we have learned, and also um, I can comprehend it more.” Similarly, after answering that he liked to write down what he learned, Eric went on to explain how his mom asks him what he learned that day and writing it down helps him remember it more easily. Because most students liked it and believed it to be helpful, most students also conveyed they would like to keep using them. As seen in Figure 2, 74% of students agreed to some extent that they would like to keep using the new exit tickets. Even one student I interviewed who originally said he was not a fan of the new exit tickets because they were hard, mentioned that it would be great if we kept using them – just not every day. Seeing that students found cognitive benefits that accompanied the new exit tickets lends to the understanding that they sensed a difference in their mental processing while completing them. This is an idea that will be touched upon further in the following section.

Another sub theme I found that corresponds to a positive perception of the new exit ticket was the factors that made completing them easier. For example, when interviewed about completing the new exit ticket, several students addressed the fact that some days were easier than others. Some students thought the new exit ticket was easy, and some thought it was consistently hard, yet most students agreed that some days were harder or easier than others. A
few of the dominating factors mentioned that affected this were interest in the material, familiarity with the material, and time given to complete the task. Similarly, I also found that most students seemed to approach the task in the same way. When asked what went through their head when they were given one of the new exit tickets, most students explained how they thought back to the day’s lesson and then just thought of a question that went along with that material. Some indicated that they put a little bit more thought into the difficulty of the question, but generally, the approaches were the same. In the midst of the data collection period, I found it amusing to read through the student responses each day because it became obvious what was standing out to students each day. On several different occasions, the questions that students were generating mirrored one another’s almost to a tee. This phenomenon most often occurred when there was some sort of interesting fact that was a small component of the lesson. Figures 3 and 4 show an example of this occurrence.

![Figure 3](image1.png)

*Figure 3. Similar question written.*

![Figure 4](image2.png)

*Figure 4. Similar question written.*

**Perceptions of Student Metacognitive Levels**
This theme was difficult to formulate due to the scattered direction it often took; yet, the underlying nature of it informed the majority of this study. I originally wanted to name this level 2 code “low levels of metacognition,” but there were just enough instances of metacognition being used that that appraisal did not accurately fit. I do still think a majority of my students demonstrated a fairly low level of metacognitive ability; however, I needed to give credit where credit was due.

One of the instances in which the students I interviewed seemed to be demonstrating some metacognitive ability was in their awareness of whether or not they understood something. All students stated that they knew when they understood something and when they did not, and all explained some sort of strategy they used whenever they did not understand something. Granted, most of the strategies mentioned were either just to ask the teacher or look back over their notes, but it takes some level of self-awareness in order to partake in any sort of strategy to get back on track. One student explained how she asks herself a series of questions in order to monitor her level of understanding; however, she also explained how the questions she was prompted to write each day were simple statement questions, indicating that not much higher-order thinking was being demonstrated.

An indication of low levels of metacognitive ability came from a common response during student interviews to the question, “How do you think you could make your questions more difficult?” Most of the students responded by saying things such as using their note sheet, using more difficult words, or just making them “better.” In other words, there was no regard for the type of question they could give or the factors that really do make a question more difficult. Another piece of evidence that demonstrates this same thought is found in the lack of growth in their ability to write a question. I was expecting to see some improvement in the questions that
students were generating; however, there was no trend in increased quality during the implementation period. The next section will show the lack of direction their written responses followed. I think the brevity of the unit and the general inexperience with writing questions did not allow for the growth in their writing ability like I anticipated. The lack of growth and the high percentage of unanswerable questions are other factors that make me believe these students were operating with just the basic metacognitive skills. See Appendix C to find the breakdown percentages of participant-generated questions.

**What They Wrote**

When analyzing the test questions that were generated, I used three different measures. The first measure looked at what level of Bloom’s (1956) Taxonomy the question demonstrated, the second looked at the difficulty level of the answer choices given, and the third looked at the originality of their question and whether or not it was answerable.

For the first measure, I gave each question a colored dot depending on what level of Bloom’s (1956) Taxonomy it represented. In this taxonomy, levels take the shape of a pyramid with the bottom being the most basic level of thinking and the top representing the highest level of thinking. A representation of this pyramid can be found in Appendix B. A red dot represented the knowledge level, a blue dot represented the comprehension level, a green dot represented the application level, and a purple dot represented the analysis level. Levels beyond analysis were not present in the questions generated by the participants. Figure 5 shows an example of a knowledge-leveled question, represented with a red dot. Figure 6 shows an example of a comprehension-leveled question, represented with a blue dot.
During the twelve days of the implementation, participants largely worked within the knowledge level with 72% of the questions they wrote receiving a red dot. There was variation in the number of questions representing the knowledge level with each day; however, a consistent trend was not found. A complete breakdown of the three measures can be found in Appendix C.

The second measure dealt with the difficulty of the answer choices that were provided. Questions could earn a one, two, three, or four with the following meanings: very easy/unanswerable, average, above average, and difficulty, respectively. Figures 7, 8, 9, and 10 show an example of answer choices that received a one, two, three, and four, respectively.
Forty-nine percent of questions written received a one, and 42% of questions received a two. This indicates that a majority of the answer choices written either did not provide an actual answer to the question given, or the difficulty level was very low.

The third and final measure looked at originality and validity of the written question. Each question was given an asterisk, an X, or an exclamation point. The asterisk meant the question was directly related to the worksheet or video used during class, the X meant it was either copied word for word from the lesson or was unanswerable, and the exclamation point meant the question was a valid question. Figures 11, 12, and 13 show an example of questions that received an asterisk, an X, and an exclamation point, respectively.
Figure 11. Question received an * (Question specifically related to the lesson).

Figure 12. Question received an X (Question was copied or not answerable).

Figure 13. Question received an ! (Question was answerable).

In totality, 12% of questions received an asterisk, 37% of questions received an X, and 51% percent of questions received an exclamation point. Again, there was not a consistent trend with any of these symbols through the implementation study.

How They Scored
To see what happened to the participants’ test scores, and because my population size was not suited to be split into a control group and experimental group, I took the average test scores from a pre- and post-test on two different unit tests. On the first unit, I did not implement the new exit ticket; therefore, this unit was used as the control. The second unit served as the experimental, for the exit ticket was implemented. Figure 14 shows the average score on all four tests.

Looking at the test score data, there is a slight increase in the growth rate from the control unit to the variable unit. Participants started lower and ended higher on the variable unit; however, this minuscule increase does not seem to be drastic enough to give the new exit tickets responsibility for that change.

There are a few reasons for the lack of significant change in these test scores. For one, these scores were taken from two different units. I took pre- and post-test data on both units in attempt to maintain some sense of consistency, yet I could not escape the fact that the material in

![Figure 14. Test score data.](image-url)
these two units was different – leaving room for inconsistencies in the difficulty level. Another factor that I think may have led to the small change in test scores was the level of metacognition my students were operating at during both units. While I do think their use of metacognition was higher during the variable unit, their familiarity with this type of thinking was well underdeveloped. Thus, the small amount of time they had with a different type of thinking did not allow for enough progress to emerge, which leads to my last reason – lack of time. Because the unit was less than three weeks, there was not much room to develop their ability to take on the new exit ticket.

**Implications for Teachers**

A few underlying ideas for future classroom practice became apparent throughout the data collection and analysis periods, as well as some areas of improvement should the study be conducted again.

The most apparent, and concerning, concept that emerged was the mismatch between awareness of metacognition and actually using metacognitive strategies in the classroom. This seems to be indicative of the lack of opportunities students are given to dig into their metacognitive abilities. Using metacognition inside the head is one thing, but using it to get learning outside the head is another. Metacognition is something that should be explicitly taught, demonstrated, and practiced. We cannot take the liberty of assuming students know how they think and best learn; we must show them ways of learning, ways of monitoring that learning, and ways of getting that learning out. I think if we build metacognition into our curriculums, we will build independent learners.

A valuable concept that arose was the idea that a majority of participants liked the new style of exit ticket because they believed it helped them as learners. This is something that should
not be taken lightly. If students feel in control of their learning, engagement and excitement will follow. I would urge teachers to make use of some sort of practice in which students are tasked with generating their own questions because this sense of ownership is likely to result.

Additionally, the large amount of “this is hard” statements that I gathered helps aid the realization that students are not used to thinking in a way that requires them to produce the answer, not just circle one. In addition to the freedom of thought that accompanies generating your own question, the mental capacity and awareness of the material it takes to do such a task is irreplaceable. I do think it became just a thing to get done as the study went on because the participants knew they would have to do it; however, I think a similar practice, used frequently, would aid student learning tremendously.

There are a few things I would alter if I were to conduct the study again. First, I believe having a control group and an experimental group for one unit would take away a large amount of ambiguity. It is difficult to use two different units because they are different units. One unit may naturally be more difficult than another, and vice versa. This particular study, however, did not lend itself to that due to the limited number of participants.

Another factor that would improve the results of this study is the length of the implementation period. Because I was using a single unit, time with the implementation (the new exit ticket) was constrained to about two and a half weeks. This did not leave enough time for participants to familiarize themselves with the task, receive proper feedback and training, or experience any real amount of growth. I believe there would have been a clearer trend of growth in their ability to write a test question had their time spent with the task been longer. Having said that, I would suggest using multiple units of curriculum. Not only would that provide the
participants more time with the implementation, but it would also provide validity to the study if consistent results were found between units.

The use of metacognition in the classroom is an unsaturated topic of study. Further research on the use of metacognitive strategies in the classroom, I believe, would help drive education into a more efficient and successful realm. If being taught and applied, metacognition will empower students to take more ownership of their learning, thus transferring a portion of responsibility over to the student. Furthermore, if students are becoming aware of their mental processes and being exposed to higher levels of thinking while in the classroom, independent learning will follow.
References


## Appendix A

### Codebook

<table>
<thead>
<tr>
<th>Code Name</th>
<th>Level</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies used when confused</td>
<td>Level 1</td>
<td>What students said they did when they did not understand something</td>
<td>“I either raise my hand and ask for help or um go back over the stuff we’ve already went over on the paper and try to figure it out.”</td>
</tr>
<tr>
<td>Perceptions toward the new exit ticket</td>
<td>Level 1</td>
<td>Thoughts and opinions on the new exit ticket style</td>
<td>“I think we should do them every day, but like, maybe on like on day once… a day once a week we shouldn’t do them.”</td>
</tr>
<tr>
<td>Perceptions of the old exit ticket</td>
<td>Level 1</td>
<td>Thought and opinions on the old exit ticket style</td>
<td>“They’re easier.”</td>
</tr>
<tr>
<td>Perceptions toward Science</td>
<td>Level 1</td>
<td>Thoughts and opinions about Science class</td>
<td>“I don’t know. It’s just, it’s just more fun and you do cooler stuff.”</td>
</tr>
<tr>
<td>Things that make the new exit ticket</td>
<td>Level 1</td>
<td>Strategies or factors that affect completing the new exit ticket</td>
<td>“As long as I pay attention, I know what to write.”</td>
</tr>
<tr>
<td>Change in ability to write a test question</td>
<td>Level 1</td>
<td>Differences in ability to write a test question during implementation period</td>
<td>“Because the process can get… gets easier over time.”</td>
</tr>
<tr>
<td>Approaches to completing the new exit ticket</td>
<td>Level 1</td>
<td>Steps taken to complete the new exit ticket</td>
<td>“Think back to what we learned in class,” and “then, think of a question that goes along with what you did in class and think of an answer.”</td>
</tr>
<tr>
<td>No experience writing test questions</td>
<td>Level 1</td>
<td>Students had never been asked to write a question before</td>
<td>“Have you ever had experience writing your own question?” “No. Not really.”</td>
</tr>
<tr>
<td>Writing test questions is hard</td>
<td>Level 1</td>
<td>Writing a question is a difficult task</td>
<td>“It’s… it’s just hard.”</td>
</tr>
<tr>
<td>Awareness of level of understanding</td>
<td>Level 1</td>
<td>Students knew when they understood something or not</td>
<td>“Well, every time I tried to answer a question, or we played a game like Kahoot, uh I would try to answer it, but I would never get the right answer. I was like, ‘I need help’.”</td>
</tr>
<tr>
<td>Thoughts put forth in their questions</td>
<td>Level 1</td>
<td>Ideas students had about creating a question</td>
<td>“I think about the things that I liked about the lesson, and I write it down. And then, I think of a complicated question, and I ask</td>
</tr>
<tr>
<td>Perceptions of seeing their question again</td>
<td>Level 1</td>
<td>Thoughts and feelings on what it would be like to see their own question on a test</td>
<td>“It’d be cool cause you know, I’d know the answer.”</td>
</tr>
<tr>
<td>How the new exit tickets have helped</td>
<td>Level 1</td>
<td>Ways in which students believed the new exit tickets have helped them</td>
<td>“Like I can understand it better, and I can grasp the concept.”</td>
</tr>
<tr>
<td>Perception of their own question</td>
<td>Level 1</td>
<td>Thoughts and opinions on the quality of students’ own question</td>
<td>“Cause I just um I would be shocked because to me, I wouldn’t think that it would be a good question.”</td>
</tr>
<tr>
<td>Writing test questions is hard</td>
<td>Level 2</td>
<td>Writing a question is a difficult task</td>
<td>“Yes because the answers they give you, and no, because I think sometimes it could cause someone stress.”</td>
</tr>
<tr>
<td>Positive perception of the new exit ticket</td>
<td>Level 2</td>
<td>Students held positive thoughts and opinions of the new exit ticket</td>
<td>“Cause of like… I don’t know. I just like these newer ones because like I like to write down what I learned and stuff.”</td>
</tr>
<tr>
<td>Perception of student metacognitive levels</td>
<td>Level 2</td>
<td>Student and teacher ideas on where students are metacognitively</td>
<td>“Well if we get like a paper that have the questions, I can look at them, and I can try to think about what they mean, and I could probably just handle it.”</td>
</tr>
</tbody>
</table>
Appendix B

Bloom’s Taxonomy Pyramid

In this study, the following colors indicated the above levels:

- Red = Knowledge
- Blue = Comprehension
- Green = Application
- Purple = Analysis
### Appendix C

**Student Generated Question Breakdown**

<table>
<thead>
<tr>
<th>Knowledge Level</th>
<th>Comprehension Level</th>
<th>Application Level</th>
<th>Analysis Level</th>
<th>Answer Choices - 1</th>
<th>Answer Choices - 2</th>
<th>Answer Choices - 3</th>
<th>Answer Choices - 4</th>
<th>Question - *</th>
<th>Question - X</th>
<th>Question - !</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/31</td>
<td>77%</td>
<td>18%</td>
<td>0%</td>
<td>5%</td>
<td>41%</td>
<td>36%</td>
<td>14%</td>
<td>9%</td>
<td>5%</td>
<td>41%</td>
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<tr>
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<td>9%</td>
<td>5%</td>
<td>0%</td>
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<td><strong>Total</strong></td>
<td><strong>72%</strong></td>
<td><strong>24%</strong></td>
<td><strong>4%</strong></td>
<td><strong>&gt;1%</strong></td>
<td><strong>49%</strong></td>
<td><strong>42%</strong></td>
<td><strong>7%</strong></td>
<td><strong>2%</strong></td>
<td><strong>12%</strong></td>
<td><strong>37%</strong></td>
</tr>
</tbody>
</table>

- **Knowledge Level** = First of six levels of Bloom’s Taxonomy of cognitive development
- **Comprehension Level** = Second of six levels of Bloom’s Taxonomy of cognitive development
- **Application Level** = Third of six levels of Bloom’s Taxonomy of cognitive development
- **Analysis** = Four of six levels of Bloom’s Taxonomy of cognitive development
- **Answer Choices – 1** = Answer choices given with question were either very easy or not answerable
- **Answer Choices – 2** = Answer choices given with question were average
- **Answer Choices – 3** = Answer choices given with question were above average
- **Answer Choices – 4** = Answer choices given with question were difficult

- **Question – *** = Question was specifically related to the worksheet or lesson
- **Question – X** = Question was copied from worksheet or was unanswerable
- **Question – !** = Question was answerable